

ISSN 1061-3781

BULLETIN OF AMERICAN
ODONATOLOGY

Volume 6 Number 2
15 Dec 2000

THE ODONATA OF IOWA
Robert W. Cruden and O. J. Gode, Jr., p. 13-48

THE DRAGONFLY SOCIETY OF THE AMERICAS

Business address: c/o T. Donnelly, 2091 Partridge Lane, Binghamton NY 13903

EXECUTIVE COUNCIL 1999-2001

President	M. May	Cranbury NJ
President Elect	D. Paulson	Seattle WA
Immediate past President	K. Tennessen	Florence AL
Vice President, SIO Affairs	M. Westfall, Jr.	Gainesville FL
Vice President, Canada	R. Cannings	Victoria, British Columbia
Vice President, Latin America	R. Novelo G.	Jalapa, Veracruz
Secretary	S. Dunkle	Plano TX
Treasurer	J. Daigle	Tallahassee FL
Editor in Chief	T. Donnelly	Binghamton NY
Regular member	R. Beckemeyer	Wichita KA
Regular member	J. Abbott	Denton TX
Regular member	S. Valley	Albany OR

JOURNALS PUBLISHED BY THE SOCIETY

ARGIA, the quarterly news journal of the **DSA**, is devoted to non-technical papers and news items relating to nearly every aspect of the study of Odonata and the people who are interested in them. The editor especially welcomes reports of studies in progress, news of forthcoming meetings, commentaries on species, habitat conservation, noteworthy occurrences, personal news items, accounts of meetings and collecting trips, and reviews of technical and non-technical publications. Articles for publication in **ARGIA** should preferably be submitted as hard copy and (if over 500 words) also on floppy disk (3.5" or 5.25"). The editor prefers MS DOS based files, preferably written in WORD, WORD for WINDOWS, WordPerfect, or WordStar. Macintosh WORD disks can be handled. All files should be submitted **unformatted and without paragraph indents**. Each submission should be accompanied by a text (=ASCII) file. Other languages should be submitted only as text (=ASCII) files. Line drawings are acceptable as illustrations.

T. Donnelly (address below) is the interim editor of **ARGIA**.

BULLETIN OF AMERICAN ODONATOLOGY is devoted to studies of Odonata of the New World. This journal considers a wide range of topics for publication, including faunal synopses, behavioral studies, ecological studies, etc. The **BAO** publishes taxonomic studies but will not consider the publication of new names at any taxonomic level. Enquiries and submission of manuscripts should be made to **BAO** editor T. Donnelly, 2091 Partridge Lane, Binghamton NY 13903. Final submissions (after review) should be made on floppy disk, as above, with illustrations in final form and preferably adjusted to final size.

MEMBERSHIP IN THE DRAGONFLY SOCIETY OF THE AMERICAS

Membership in the **DSA** is open to any person in any country. Dues for individuals in the US, Canada, or Latin America are \$15 for regular membership and \$20 for contributing membership, payable annually on or before 1 March of membership year. Dues for members in the Old World are \$20. **ARGIA** is mailed Air Mail outside of the US and Mexico, and First Class in those countries.

The **BULLETIN OF AMERICAN ODONATOLOGY** is available by a separate subscription at \$15 for members and \$18.75 for non-members and institutions.

THE ODONATA OF IOWA¹

Robert W. Cruden, Department of Biological Sciences, University of Iowa, Iowa City, IA 52242 e-mail: robert-cruden@uiowa.edu

O. J. Gode, Jr., 264 N. Calle del Santo, Green Valley, AZ 85614 e-mail: budgode@aol.com

ABSTRACT

We report 108 species from Iowa, which include 103 species collected since 1985, two accidentals, and three species that were probably extirpated many decades ago. We discuss reports of 20 additional species whose presence in the state is questionable. As many as 31 species may be imperiled or critically imperiled. This reflects, at least in part, that the distributional ranges of 19 species barely reach Iowa. Most of the imperiled species occur in lotic habitats or wetlands, habitats most affected by human activity. Dramatic post-settlement changes in the state's river systems were followed by the movement of species into lotic systems, e.g., *Argia moesta*, *Enallagma anna*, *Gomphus externus*, *Progomphus obscurus*, and *Stylurus notatus*. Three species, i.e., *Hagenius brevistylus*, *Gomphus fraternus*, *G. exilis*, have become less common or were extirpated due to stream degradation. Further, prior to settlement there were few deep lakes and ponds in the state and virtually no wetlands or ponds in southern Iowa. The construction of farm ponds, gravel pits, etc., and the elimination of wetlands dramatically changed the lentic fauna. Species that were absent from Iowa, rare, or restricted to eastern Iowa early in the 1900s are now common across the state, e.g., *Epitheca princeps*, *Celithemis eponina*, and *Perithemis tenera*. In contrast, at least one wetland species was possibly extirpated, i.e., *Lestes vigilax*, and the ranges of others probably contracted, e.g., *Aeshna verticalis*, *Nasiaeschna pentacantha*, and *Sympetrum ambiguum*.

INTRODUCTION

Although the first report dealing with Iowa's odonates was published over a century ago (Elrod 1898), and subsequent workers contributed to our knowledge of what species lived in the state (Miller 1906; Wilson 1909, 1921; Whedon 1912; Wells 1917; Hoffman 1924; Yeager 1932; Loudon 1933; Hummel 1978; Hummel and Haman 1975, 1977), the first comprehensive treatment of the state's dragonflies and damselflies was not published until 1998 (Cruden and Gode 1998; but see Whedon 1912). In our 1998 paper we reviewed the literature

and provided a list of the species reported from the state as of 1997. The papers and a thesis written early in the century (Elrod 1898; Miller 1906; Wilson 1909, 1921; Whedon 1912; Wells 1917; Hoffman 1924) provided sufficient data to allow us to examine changes in the odonate fauna during the past century. Those changes reflected major changes in Iowa's aquatic habitats.

Our earlier paper did not provide a detailed account of the distribution of species within the state and provided few details of Iowa's landforms and how they affected the distributional patterns of the state's odonates. Here we describe the distribution of 103 species collected within the state in the past 15 years, and discuss 25 species reported from the state that we have not encountered. Some of the latter may be extinct and others may never have occurred in the state. We discuss Iowa's landforms and river systems in sufficient detail to enable the reader to appreciate how changes in Iowa's landscape have altered the distributional patterns of numerous species during the past century and a half.

An understanding of where species occur in Iowa may be important to understanding their national distributional ranges because the ranges of many species reach their limit in Iowa. Because we collected in all of Iowa's 99 counties, which are relatively small, our sampling, viewed from a national perspective, is relatively fine grained. This provides a relatively sharp resolution of the edges of those distributional ranges.

IOWA'S LANDSCAPE

With a land surface of 55,986 square miles, Iowa is smaller than most of its neighbors but is slightly larger than Wisconsin and Illinois. With the exception of the Paleozoic Plateau and Loess Hills (Fig. 1), there is little topographic relief. In the southeast corner of the state the elevation is approximately 145 m and slowly increases to the northwest where the elevation reaches 506 m in Osceola County. The eastern and western borders are formed by the Mississippi River and the Missouri and Big Sioux Rivers, respectively (Fig.

¹ Bulletin of American Odonatology, 2000, 6(2): 13 - 48

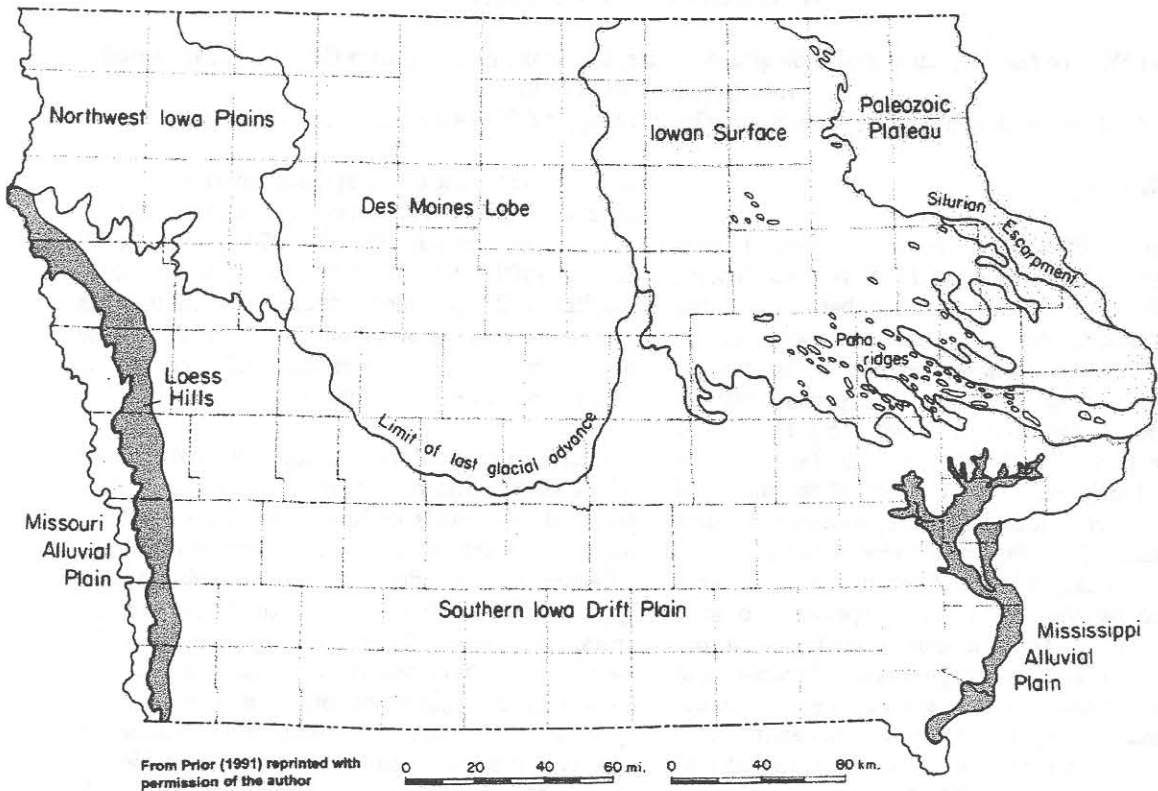


Fig. 1 Land Forms of Iowa

2). The border with Missouri is at approximately 40°35' N latitude and that with Minnesota is at approximately 43°30' N latitude. Approximately 80% (26-28 million acres) of presettlement Iowa was covered by prairie and less than 0.1% of this remains (Smith 1998). There was some forest and savannah in the eastern part of the state, and also along the rivers and large creeks. Of Iowa's approximately 6 million acres of presettlement wetlands, less than 11% remains (Bishop et. al. 1998).

Most of the state is drained by rivers that flow southeastward to the Mississippi River, e.g., the Des Moines, Skunk, Cedar, and Wapsipicon Rivers (8-11, Fig. 2). The source of the Des Moines is in southwestern Minnesota just north of Dickinson County. These rivers provided a direct route for creek and river species to move from eastern to western Iowa. Northeast Iowa is drained by rivers that flow eastward to the Mississippi River, e.g., the Turkey, Yellow, and Upper Iowa (12-14, Fig. 2). Western and southwest Iowa are drained by rivers that flow southwestward to the Missouri River, e.g., the Floyd, Maple, and Boyer

(1-3, Fig. 2), or south into Missouri before reaching the Missouri River, e.g., the Nishnabotna, Nodaway, Platte, and Thompson (4-7, Fig. 2).

All of Iowa's landforms (Fig. 1) were shaped directly by the action of glaciers, the extreme climatic conditions during the last glacial period, and/or the action of wind and water associated with glacial activity. The following descriptions were abstracted from Prior's (1991) marvelous account of Iowa's landforms.

DES MOINES LOBE: This region was shaped by the last advance of the Wisconsin glaciation 14,000 to 12,000 years ago. The surface is characterized by knobs (higher areas) and kettles (depressions). At the time of settlement the knobs were covered by prairie and the depressions were prairie potholes and wetlands, most, if not all, of which were ephemeral. Although the region is crossed by three rivers, it is geologically too young to have the well developed river systems that characterize the other regions.

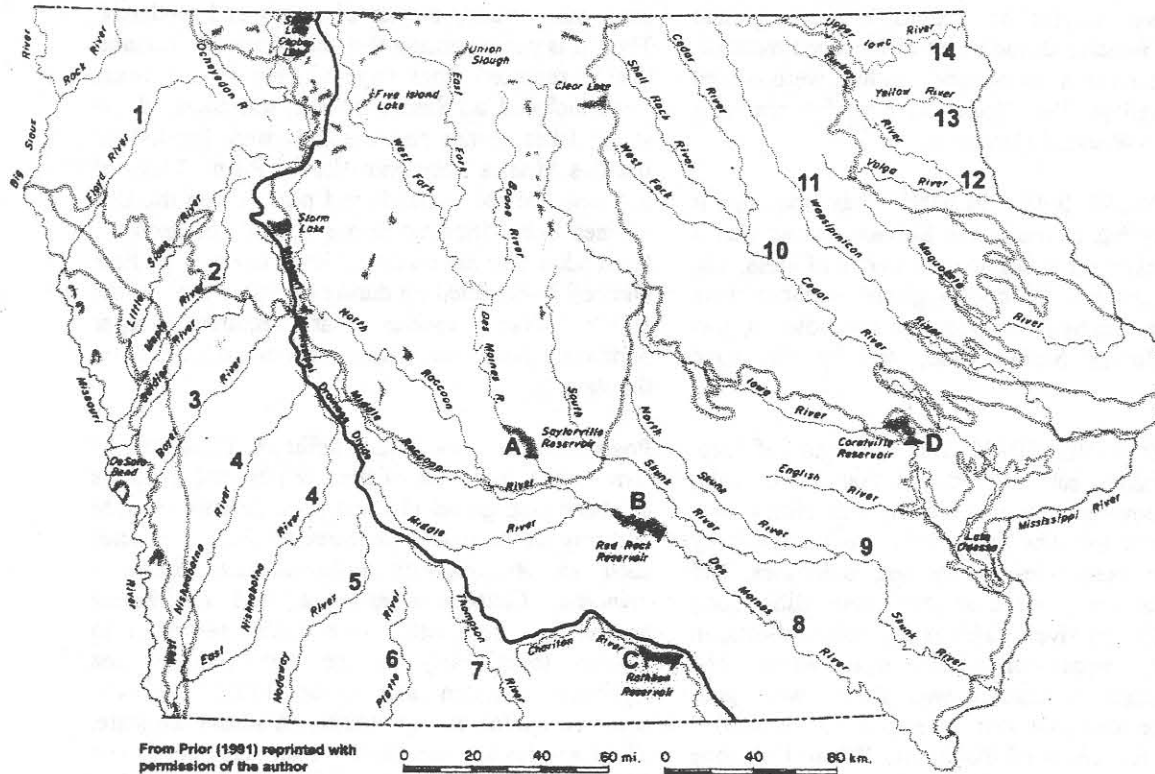


Fig. 2. Major rivers in Iowa. The darker line marks the divide between the Missouri and Mississippi River drainage systems. The numbers indicate the following rivers: 1=Floyd; 2=Maple, 3=Boyer; 4=W. and E. Nishnabotna, respectively; 5=Nodaway; 6=Platte; 7=Thompson; 8=Des Moines; 9=Skunk; 10=Cedar; 11=Wapsipipicon; 12=Turkey; 13=Yellow; and 14=Upper Iowa. The four reservoirs are indicated by letters: A=Saylorville; B=Red Rock; C=Rathbun; and D=Coralville.

LOESS HILLS: This region is characterized by steep hills and ridges that arise abruptly from the flood plain of the Missouri River and extend from north of Sioux City (Plymouth County) south into Missouri. The hills are mostly loess (wind blown silt composed primarily of closely packed grains of quartz) deposited 31,000 to 12,500 years ago. This highly dissected landscape reflects the combined effects of wind deposition, erosion by entrenched streams, and slumping due to erosion. Prior to settlement these hills were covered primarily by prairie with small patches of forest and/or savannah on north and east facing slopes. This landscape is easily eroded and subject to gully erosion, such that to-day, even small streams flow between steep sided banks that may be 10-20 feet high (see Prior, 1991, p. 56).

SOUTHERN IOWA DRIFT PLAIN: This is a pre-Illinoian glacial surface that reflects 300,000 to 500,000 years of erosion. During this time dendritic

river systems developed, which produced a dissected landscape dominated by relatively steep hills and valleys. In the upper reaches of these systems the streams are tiny and seasonal. These merge to form larger streams, which combine to form creeks, and eventually rivers. Because of the well-developed river systems there is little evidence of the original knob and kettle topography, and, as a consequence, very few natural ponds and wetlands. Most of the latter were on the flood plains and terraces along major rivers.

IOWAN SURFACE: This region is characterized by gently rolling hills with long slopes and low relief. There are well-developed river systems and few areas of poor drainage and few natural wetlands. Prior to the last glaciation the landscape was similar to the Southern Drift Plain. That older landscape was dramatically altered by erosion and re-deposition 21,000 to 16,500 years ago. During that time the region was covered by tundra and the

hills were subject to extensive freezing and thawing, massive dislodgment of loosened material, and sheet erosion. In essence, the hills were eroded and the valleys filled. Today there are few remnants of the pre-Wisconsin landscape.

NORTHWEST IOWA PLAINS: This landscape is similar to that of the Iowan Surface, except that it has a thicker, more continuous mantle of loess. The pre-Illinoian and Wisconsin glacial surfaces were altered by intensive erosion and redeposition, just as the Iowan Surface was, and by the same agencies.

PALEOZOIC PLATEAU: This is a region of deep, narrow valleys cut into bed rock that contain cold, rapidly flowing streams, creeks, and rivers with rocky bottoms. The steep hills are underlain by Paleozoic sandstones, limestones, dolomites, and shales that are exposed as precipitous cliffs along the creeks and rivers. This topography reflects, in part, the impact of glacial melt water. The presettlement vegetation was forest with goat prairies on thin soils that developed on steep-sided hillsides, the edges of bluffs, etc. Where limestone is close to the surface, there is karst formation and some sink holes have filled with ground water and form natural ponds and wetlands.

ALLUVIAL PLAINS: These are the flood plains that border the state's major rivers, i.e., the Missouri and Mississippi Rivers, and their major tributaries. Their wide flood plains reflect the action of melt water from past glaciers and the flat surfaces reflect the deposition of water born sediments. Due to the propensity of rivers to change their channels, these flood plains include depressions where the river once meandered. Such abandoned meanders or oxbows formed small lakes, bayous, ponds, wetlands, and depressions that were seasonally wet. The great width of some river valleys, compared to their rivers relatively small width, resulted from the great volumes of water released during periods of glacial melting during the close of the Wisconsin glacial episode.

HABITATS and FAUNA: Lakes, Ponds, and Wetlands

Prior to settlement, Iowa's landforms strongly influenced the distributional patterns of the state's dragonflies and damselflies and today's fauna reflects a landscape that has been tremendously altered by human activity. Presettlement Iowa had very few large lakes and relatively few permanent ponds and small lakes, and the southern half of the

state was virtually devoid of ponds and wetlands. Thus, it is not surprising that the 16 species Loudon (1933) reported from Page County in southwest Iowa included no *Lestes* or *Aeshna*. Most of the state's lakes, ponds and wetlands were located on the Des Moines Lobe and Alluvial Plains. Many, if not most, of the wetlands and potholes on the Des Moines Lobe dried up during periods of drought. Even lakes that are relatively large today, e.g., East Okoboji Lake, dried up during droughts early in the 1900's. Thus, species that required deeper permanent ponds were either rare or excluded from the state.

Postsettlement Iowa is quite different. Thousands of farm ponds, hundreds of borrow pits, and numbers of abandoned gravel pits and rock quarries provide an array of deep and permanent habitats. Species such as *Arigomphus submedianus*, *Epitheca princeps*, *Celithemis eponina*, and *Perithemis tenera* that were either rare and/or restricted to eastern Iowa early in the last century (see Appendix; Cruden and Gode 1998) are now common and/or widely distributed across the state. Three species are restricted to man made ponds and lakes in southern Iowa, i.e., *Dromogomphus spoliatus*, *Gomphus militaris* and *Libellula cyanea*.

Nearly all of the shallow, ephemeral wetlands and potholes that once covered much of the Des Moines Lobe have disappeared (Bishop et al. 1998), as have wetlands elsewhere in Iowa. The loss of these habitats may explain the disappearance of *Lestes vigilax* and the reduction in the distributional ranges of *Aeshna canadensis*, *A. verticalis*, and *Nasiaeschna pentacantha* (see distributional maps and/or species accounts). Likewise, nearly all of the wetlands and sloughs on the Alluvial Plains were drained or filled. These were home to *Sympetrum ambiguum* and *Macromia taeniolata*, as well as species that now are common in deeper ponds and lakes across the state (see Cruden and Gode 1998). Our failure to find *S. ambiguum* elsewhere in Iowa suggests that it was restricted to the Mississippi Alluvial Plain prior to settlement.

Odonates are virtually absent from Iowa's large reservoirs that were built for flood control. These include Coralville, Rathbun, Red Rock, and Saylorville Reservoirs (A-D, Fig. 2). The 10-20 (-40) foot changes in water level may create an environment in which few odonates can survive.

HABITATS and FAUNA: Streams, Creeks, and Rivers

Presettlement streams and creeks were protected by the prairie, which soaked up the rain (Baker 1996), thus minimizing runoff. A century ago geologists described streams in the northern half of the state with terms such as, "flowing in a shallow depression", "flowing in troughs", and "barely below the level of the adjacent prairie". Photographs of larger creeks and small rivers from that era show three to four foot banks, most of which were sloping rather than vertical. The bottoms of the streams and creeks surely reflected the nature of the surrounding land, as they do today. Clear water flowed over sandy, gravelly, or rocky bottoms. Siltation was minimal in streams and smaller creeks but was surely an environmental factor in the Mississippi River and the lower reaches of its major tributaries.

Iowa's river systems have undergone great change since settlement due to agricultural and other human activities. After the prairie was plowed, it was tiled, streams were straightened and deepened, and drainage ditches dug to expedite the movement of water from the fields. The tile lines emptied into the deepened streams and drainage ditches. The rapid movement of water into the streams and creeks resulted in flooding, gully erosion, and heavy silt loads. In Page County, and undoubtedly elsewhere in the Southern Iowa Drift Plain, the ". . . cutting of drainage ditches along roadsides or for the passage of water under road culverts. . ." initiated headwater erosion, which very quickly resulted in deep, V-shaped trenches (Calvin 1901, p.409-410). Today silt is ubiquitous in Iowa's waterways, most of which flow between steep sided banks that are frequently 10 or more feet high.

River systems and the associated fauna were changed by other human activities. Streams and creeks that run through pastures are subject to damage from cows that use them as a source of water or place to escape the summer's heat. The rocky bottomed streams and creeks of northeast Iowa are trout 'streams', most of which, the Iowa Department of Natural Resources stocks with hatchery reared fry. Both the numbers of individuals and species of odonates on most of these streams and creeks are low relative to those elsewhere in the state. Finally, many streams and creeks are bordered by woods and forest that produce a deep shade. Only an occasional *Calopteryx* is found in such habitats. In

presettlement Iowa most of the streams and creeks were bordered by prairie, not by forest.

The most profoundly altered river systems in Iowa are those that flow southwest into the Missouri River (Fig. 2). Many, if not most, of the large creeks and rivers were straightened and the lower reaches flow for miles between levees. Many are little more than huge drainage ditches. The streams and smaller creeks flow between steep, high banks and are frequently muddy bottomed. Such streams support a limited fauna compared to streams with sandy or silty bottoms. We have not collected seven species in far western Iowa that are relatively common in creeks and rivers elsewhere in the state. These include *Progomphus obscurus*, *Stylurus* spp., *Boyeria vinosa*, *Hetaerina titia*, *Argia moesta*, and *Enallagma exsulans*. Because most of these species occur in Nebraska and Kansas we anticipate finding them in western Iowa even though appropriate habitat is uncommon. Our limited collecting along the Missouri River suggests that few species presently live in it.

Both the Mississippi and Missouri River flood plains, i.e. the Alluvial Plains, have undergone great change. Virtually all the wetlands, ponds, etc. associated with these rivers have disappeared. In addition, the locks and dams on the Mississippi River either drowned or altered the wild river and created large impoundments where there were once wetlands and bayous. At the very least, wetland and river species suffered tremendous habitat loss, as well as decreases in population size (Cruden and Gode 1998). Several species that were reported from the river early in the last century are gone, e.g., *Macromia illinoiensis*, or quite rare, e.g., *Stylurus amnicola* (also see Cruden and Gode, 1998).

The present river systems provide an array of habitats based on their breadth, depth, and nature of the bottom. Based on breadth and depth we recognize streams (1-10 feet across and shallow), creeks (10-30 feet across, and wadeable during the summer, or wider, if wadeable during the summer), and rivers (100 or more feet across and frequently not wadeable even in a drought year). Various species, including *Aeshna umbrosa*, *Somatochlora ensigera*, *Archilestes grandis*, *Argia plana* and *Enallagma anna* are nearly always found along streams, whereas *Boyeria vinosa*, *Hetaerina titia*, *Argia moesta* and *A. tibialis* inhabit creeks and small rivers. Several species, including *Neurocordulia molesta*, *Gomphus fraternus*, and *G. vastus*, frequent larger rivers. The fauna also

reflects, at least in part, whether the bottom is rocky, gravelly, sandy or muddy. For example, the various species of *Stylurus*, and *Progomphus obscurus* are associated with sandy bottomed creeks and rivers, and *Macromia illinoensis* with rocky and/or gravelly bottomed creeks.

There is some evidence that changes in Iowa's river systems were accompanied by changes in the fauna, including the extirpation of *Hagenius brevistylus* and possibly *Gomphus exilis*, a reduction in the distributional range of *Gomphus fraternus* and possibly other species, and the movement of a number of species into Iowa's streams, creeks and rivers. If the larvae of *H. brevistylus* lived in the debris that accumulated along the margins of creeks and rivers (Walker 1958) their habitat might have been destroyed by yearly flooding. Today one finds minimal accumulations of debris along creeks and rivers, as their beds are swept clean from bank to bank by spring floods and the debris left high on the banks or on the flood plains. Our data indicate that the range of *G. fraternus* has contracted eastward (see map). Unfortunately, there are no early records of *G. quadricolor* and *Ophiogomphus rupinsulensis*, which inhabit rapidly flowing streams and creeks (Walker 1958) and are probably relatively silt-intolerant. Thus, one might suspect that they are not as common as they once were. Both were collected at sites inhabited by silt-intolerant fish (D. Lyon, pers. comm.).

The available data are consistent with the notion that a number of species have moved into Iowa's creeks and rivers from which they may have been excluded prior to settlement (Cruden and Gode 1998). *Stylurus amnicola* was collected by Elrod (1898) and Whedon (1912) in central and western Iowa, respectively, but neither collected *S. notatus* or *S. plagiatus*, both of which occurred in the Mississippi River at that time (Wells 1917, Wilson 1921). Today the three species are distributed widely across the state (see maps), and *S. amnicola* frequently co-occurs with one or both of the other species. This is consistent with *S. notatus* and *S. plagiatus* having moved westward into Iowa's creeks and rivers since 1920. Likewise, *Argia moesta*, *Enallagma exsulans*, *Gomphus externus* and *Progomphus obscurus* were reported only from eastern Iowa early in the last century (see Appendix) and are now relatively common in creeks and small rivers across much of the state. The failure of previous workers to collect either *Argia plana* or *Enallagma anna* (see Bick et al. 1977 for the first report of *E. anna* in Iowa) is consistent with these species being postsettlement

additions to Iowa's fauna (Cruden and Gode 1998). Also, *Archilestes grandis* is undoubtedly a postsettlement addition to Iowa's fauna (see Westfall and May 1996). There is no evidence that the movement of these species into Iowa's streams, creeks and rivers resulted in the replacement of silt-intolerant species or what had excluded those species from Iowa's river systems prior to settlement.

Finally, the Southern Iowa Drift Plain may have excluded stream species, just as it excluded wetland and pond species. Based on our records five stream species, i.e., *Archilestes grandis*, *Argia alberta*, *A. plana*, *Enallagma anna*, and *Aeshna umbrosa*, appeared to be less common in the lower three tiers of counties relative to the rest of the state (see maps). To test that observation we examined the presence of stream species in the two regions with a 2X2 Contingency Table. We scored streams and possibly a few small creeks in the two regions for the presence of *Calopteryx* spp., *Hetaerina americana*, the five stream species listed above plus *Somatochlora ensigera* and five creek species that sometimes co-occur with them, i.e., *A. f. violacea*, *E. antennatum*, *E. exsulans*, *Ischnura posita* and *Progomphus obscurus* plus *Amphiagrion* cf. *saucium*. *Calopteryx* spp. and *H. americana* were the most common species found on our streams and they occurred with equal frequency in streams in southern and northern Iowa ($X^2=0.077$, $p>0.5$). The stream species occurred more often in northern Iowa streams (220 present/47 absent) than in southern Iowa streams (38 present/56 absent) ($X^2=60.06$; $p<<0.001$). In contrast, the creek species were more common in southern Iowa streams (58 present/36 absent) than in northern streams (90 present/177 absent) ($X^2=22.52$; $p<<0.001$).

The relative rarity of stream species in southern Iowa may reflect differences between streams in the two regions and ease of colonization. Streams in southern Iowa have steeper gradients and are either intermittent or dry up during the summer, whereas those in northern Iowa tend to have gradual gradients and flow throughout the summer. If local populations of stream species are extirpated because the streams dry up, the absence of stream species and presence of creek species in the streams of southern Iowa may be explained by ease of colonization. Stream species have to traverse considerable distances to colonize streams whereas creek species simply have to fly upstream.

IOWA: A BIOGEOGRAPHIC CROSSROADS

Iowa's odonate fauna includes eastern, western, southern and boreal elements. Over half (n=54) of the state's species are eastern or northeastern species whose ranges extend from the east coast west to Minnesota, Iowa, South Dakota, Nebraska, Kansas, Oklahoma and/or Texas. In essence, these are species of the eastern deciduous forest region whose ranges extend into the tall grass prairie region. The ranges of a number of boreal species extend southward into Illinois, Iowa, Missouri, and Nebraska. Ten of these occur in Iowa. Nineteen of Iowa's species have transcontinental ranges. Thirteen species occur primarily in the middle of the continent, i.e., between the Appalachian and Rocky Mountains. Just seven of Iowa's species are western species whose ranges now extend east into Iowa, or in the case of *Enallagma anna*, east to Michigan and Ontario (Donnelly pers. comm.).

As many as 46 species may reach the limits of their distributional range in Iowa. Approximately 25 species reach the western edge of their range in Iowa, e.g., *Gomphus fraternus*, *G. vastus*, *Ophiogomphus rupinsulensis*, *Stylurus spiniceps*, *Aeshna verticalis*, and *Sympetrum ambiguum*. Likewise, 11 species reach the southern limit of their range in Iowa, including *Calopteryx aquabilis*, *Coenagrion resolutum*, *Enallagma ebrium* and *Nehalennia irene* and seven species reach the northern limits of their range in Iowa, including, *Arigomphus submedianus* and *Gomphus militaris*. Five western species were found entirely or primarily in western Iowa, i.e., *Aeshna multicolor*, *Stylurus intricatus*, *Argia alberta*, *A. emma*, and *Enallagma clausum*.

THE HISTORIC RECORD

We examined material collected by Wells (1917) and Hoffman (1924) and Wilson's (1909) material is at the NMNH (Adams pers. comm.). Much of the material cited by Wells (1917) is at Iowa State University. Several species that Wells (1917) reported were based on misidentifications (see Excluded and Questionable Species). Further, Wells (1917) is the only worker to report *Gomphus crassus* and *Basiaeschna janata*. He cited Wilson as his source but Wilson (1921) did not mention these species. We examined Hoffman's (1924) material at Iowa Wesleyan College and with the exception of *Gomphus furcifer* (= *Arigomphus cornutus*), *Sympetrum vicinum* (= *S. costiferum*) and *Lestes forcipatus* (= *L. disjunctus*?) the material was accurately identified. In addition, the

collection included specimens of *Sympetrum obtrusum* and *Ischnura posita* that Hoffman collected at the same time. Many of the species included in Loudon's (1933) report were based on lists provided by individuals at the State University of Iowa (=University of Iowa) and Iowa State College (=Iowa State University) with no indication as to the correspondents expertise. His list includes a number of species that were based on misidentified specimens, for example, *Arigomphus furcifer* and *Somatochlora linearis* (see Excluded and Questionable Species). The Dickinson County records of *Aeshna verticalis* and *Gomphus fraternus* were based on specimens at either Iowa Lakeside Laboratory or Iowa State University (Hummel 1978). We did not find specimens of either species from Dickinson County at either institution. We have not located material collected by other early workers. Loudon (1933) reported that Whedon's material was no longer at the University of Iowa, but provided no details. Likewise, we did not find any of Whedon's material at the University of Iowa. Our experience suggests that species in *Gomphus* and *Aeshna* were misidentified more often than species in other genera. Likewise, Oliver Flint (pers. comm.) noted numbers of changed identifications in *Aeshna* and *Gomphus* while looking for material in the NMNH that Wilson (1909) collected in Iowa.

IOWA'S RARE SPECIES

Thirty percent of Iowa's odonates may be imperiled (n=12) or critically imperiled (n=19), i.e., occur in 20 or fewer sites, and three or more species may have been extirpated in the past century (see Possibly Extirpated Species). Approximately 75% of the populations of the critically imperiled and imperiled species occur in Iowa's peripheral two tiers of counties. This is a consequence of some species barely reaching Iowa and the ranges of others having contracted. A disproportionate number of Gomphidae, Aeschnidae, and Cordulidae are imperiled whereas most Libellulidae, Calopterygidae, and Coenagrionidae are secure. A majority of the critically imperiled and imperiled species (n=19) occur in wetlands, streams, creeks, or rivers; habitats that have suffered most from human activity. The large percentage of rare species in Iowa's odonate fauna mirrors that of other states, e.g., ca. 36% of Ohio's approximately 152 species (Glotzhober 1995) and 36% of Alabama's 173 species (Tennessen, Harper, and Krotzer 1995).

Iowa's imperiled species are rare for a variety of reasons or combinations thereof. Most are rare due

Species	Number of recent sites	5 or more individuals	Tandem, mating, ovipositing
<i>Lestes forcipatus</i>	4	+	+
<i>Lestes inaequalis</i>	2	+	+
<i>Argia emma</i>	1	+	+?
<i>Enallagma boreale</i>	3	+	+
<i>Aeshna mutata</i>	1	+	-
<i>Aeshna tuberculifera</i>	1	+	-
<i>Aeshna verticalis</i>	4	+	+
<i>Epiaeschna heros</i>	1	0	0
<i>Nasiaeschna pentacantha</i>	3	+	+
<i>Gomphus militaris</i>	3	+	-
<i>Gomphus quadricolor</i>	2	+	-
<i>Ophiogomphus</i> sp.	2	+	-
<i>Ophiogomphus rupinsulensis</i>	2	+	-
<i>Stylurus intricatus</i>	2	-	-
<i>Stylurus spiniceps</i> 1 - -	1	-	-
<i>Neurocordulia molesta</i>	3	0	-
<i>Neurocordulia yamaskanensis</i>	2	0	0
<i>Libellula cyanea</i>	3	+	-
<i>Sympetrum ambiguum</i>	1	+	+
<i>Tramea carolina</i>	1	+	+

Table 1. Evidence that Iowa's rarest Odonata are resident in the state and occur in established populations. The number of sites where each species was collected is given. At most sites a minimum of five to ten, frequently more, individuals were observed. Individuals in tandem, mating and/or ovipositing are consistent with established populations. + = yes/present. - = no/not observed. 0 = no information.

to habitat loss. These include *Aeshna canadensis*, *A. verticalis*, *Nasiaeschna pentacantha*, *Libellula quadrimaculata*, *Sympetrum ambiguum*, and *Tramea carolina* and probably *Enallagma boreale*, *Gomphus quadricolor*, *Ophiogomphus* sp., *O. rupinsulensis*, and *Neurocordulia molesta*. Other imperiled species may be recent immigrants and/or just barely reach the state, e.g., *Gomphus militaris*, *Aeshna tuberculifera*, *Neurocordulia yamaskanensis*, *Libellula cyanea*, *Argia emma*, and *Enallagma clausum*. Other species were probably always rare, e.g. *Lestes forcipatus*.

Iowa's imperiled species represent all of the biogeographic groups. Most are eastern/northeastern species (n=18), which is consistent with more than half of the state's species having eastern or northeastern distributions. Two northern species are imperiled, as are five western species, five mid-continental species, and one transcontinental species.

There is evidence that most of Iowa's 20 rarest species, i.e., those collected less than five times, have resident populations (Table 1). We collected the two species of *Ophiogomphus*, *Sympetrum*

ambiguum, *Tramea carolina*, and *Lestes forcipatus* at one site twice in the last 4-5 years. More than five individuals of most species were observed at one or more sites. Also, we observed mating behavior and/or oviposition by seven of the species.

Our collecting in 1997-2000 showed that nine species that we previously reported as imperiled (Cruden and Gode 1998) are rare or uncommon. These include *Arigomphus cornutus*, *Gomphus fraternus*, *G. vastus*, *Macromia illinoiensis*, *Hetaerina titia*, *Lestes eurinus*, *Argia alberta*, *Enallagma ebrium*, and *Ischnura hastata*.

SPECIES ACCOUNTS

The following accounts include the 43 damselflies and 60 dragonflies for which there are recent records. Accidentals, questionable reports, and possibly extirpated species are discussed separately. The accounts are based primarily on our field work during the summers of 1993-2000. Our collecting effort was uneven. We collected most in eastern, central, and northwest Iowa, less in south central and north central Iowa, and least in southwest Iowa

(Fig. 3). We made more than 18,000 observations (species/site/day) that included nearly 4200 county records. We added 12 species to the state list and collected 100 of the 103 species collected in the state in the past 15 years. We also include information provided by Nancy Adams and Oliver Flint (National Museum of Natural History), William Smith (Wisconsin DNR), Jim Durbin, Steven Hummel, and Ann Johnson and specimens at Iowa State University and Iowa Lakeside Laboratory. Together these provide a record of what species occur in Iowa today and an incomplete record of what was present in the past.

The vast majority of our records were sight records or individuals that we captured and released. Many common species were identified while on the wing, e.g., *Celithemis* spp., *Erythemis simplicicollis*, *Libellula* spp. and *Perithemis tenera*. Virtually all our records for Gomphidae (*Arigomphus submedianus* and *Progomphus obscurus* excepted), Aeschnidae (Anax and *Boyeria* excepted), Macromidae, Lestidae, and most Coenagrionidae (*Argia apicalis*, a few *Enallagma*, and *Ischnura verticalis* excepted) are based on specimens that we captured, identified and released. We have vouchers for all the species we collected. The reader should consult our earlier paper for details on our methods (Cruden and Gode 1998). Our concepts of streams, creeks, and rivers are outlined above and should be interpreted liberally as they grade one into the other. Likewise there is no single characteristic that separates ponds and lakes. These usually have discrete boundaries and most were man made. In contrast, wetlands tend to be relatively shallow, have indistinct boundaries and may be ephemeral.

We present our data in three ways, i.e., with species accounts, distributional maps, and a list of counties in which each species was observed and/or collected (see Appendix). Each account includes the flight period, the number of times it was identified (sites/day), number of counties in which it was observed/collected, an indication of its national range and range within the state, our perception of its conservation status using the Natural Heritage conservation designations (see below), information on habitat, and other relevant observations. The flight seasons do not include information from the literature. The maps illustrate the present distribution (our data plus recent records provided by Jim Durbin, Steven Hummel, and Ann Johnson) and records from the literature and various museums. References to the literature are provided in the Appendix. Maps are not provided

for species that we collected in 97 or more counties, a single county, and the three species that we did not collect. The essence of the Natural Heritage conservation designations are: S1 = Critically imperiled, 1-5 occurrences, especially vulnerable to extirpation; S2 = Imperiled, 6-20 occurrences, vulnerable to extirpation; S3 = rare to uncommon, 21-100 occurrences; S4 = common, apparently secure; S5 = very common to abundant, secure; SH = Documented but not verified in the past 20-25 years; SR = Reported from the state but without persuasive evidence; SX = apparently extirpated.

SPECIES ACCOUNTS

CALOPTERYGIDAE

Calopteryx aquabilis Say

3 Jun-6 Sep (241 records/50 counties)

A northern species, at southern edge of range across central Iowa.

Common (S5) in northern half of state, streams, creeks, and smaller rivers. Based on our collections it is doubtful that this species occurred in Page County as reported by Loudon (1933).

Calopteryx maculata (Beauvois) NO MAP

27 May-16 Sep (651 records/all 99 counties)

An eastern species, throughout the state.

Common (S5), streams, creeks, and rivers.

Hetaerina americana (Fabricius)

27 May-12 Oct (428 records/90 counties)

An eastern species, throughout the state, expected in all counties.

Common (S5), streams, creeks and rivers.

Hetaerina titia (Drury)

12 Aug-28 Sep (45 records/31 counties)

An eastern species, southern 2/3 of the state, possibly at the northern edge of its range in northern Iowa.

Uncommon (S3), mostly sandy bottomed creeks and rivers, usually associated with snags. A late season species.

LESTIDAE

Archilestes grandis (Rambur)

17 Aug-7 Oct (17 records/13 counties)

A southern transcontinental species, at northern edge of range across central Iowa, but relatively rare in southern Iowa. The earliest record is from the early 1970's (Hummel and Hamen, 1977).

Rare-uncommon (S2S3), streams and small creeks. A late season species.

Lestes congener Hagen

16 Jun-17 Oct (17 records/9 counties)
 A transcontinental species, scattered localities across the state.
 Rare (S2), margins of ponds and marshes.

Lestes disjunctus australis (Walker)

15 May-25 Aug (48 records/24 counties)
 An eastern species, scattered localities throughout the state.
 Uncommon (S3), ponds and wetlands. Most of our records are from May-July. All of our material was examined by T. Donnelly. See Donnelly (2000) for a discussion of this species.

Lestes dryas Kirby

16 May-31 Jul (42 records/17 counties)
 Primarily an eastern/northern species. More or less state wide, more common in northern Iowa and possibly at edge of range in southern Iowa.
 Uncommon (S3), ephemeral pools in woods, wetlands.

Lestes eurinus Say

10 Jun-12 Aug (25 records/20 counties)
 An eastern species, scattered localities mostly in the eastern half of the state, possibly at edge of range in central Iowa.
 Uncommon (S3), primarily shallow ponds and wetlands.

Lestes forcipatus Rambur

30 May-8 Jul (6 records/5 counties)
 Primarily an eastern species whose range extends to the Rocky Mountain states, most of our collections are from eastern Iowa.
 Extremely rare (S1), ephemeral ponds and wetlands. Earlier records (see Appendix) are problematic (Westfall and May 1996). Based on our collections this species is much rarer than *L. disjunctus australis*.

Lestes inaequalis Walsh

21 Jun-24 Jun (2 records/2 counties)
 An eastern species, at western edge of its range in northeastern Iowa.
 Extremely rare (S1), ponds and wetlands. First Report for Iowa.

Lestes rectangularis Say

28 May-5 Oct (257 records/74 counties)
 An eastern species, expected in every county.
 Common (S4), wetlands and ponds, occasionally in streams.

Lestes unguiculatus Hagen

30 May-10 Oct (335 records/86 counties)
 A northern/eastern species, expected in every county.
 Common (S5), marshes, ponds, lakes, and occasionally in streams.

COENAGRIONIDAE

Amphiagrion cf. *saucium* (Burmeister)

18 May-22 Aug (82 records/46 counties)
 A mid-continental species, statewide, expected in most counties.
 Uncommon (S3), small streams, seepage areas, wetlands, and fens. Most of our material is intermediate between eastern *A. saucium* and western *A. abbreviatum*. See Westfall and May (1996) and Donnelly (2000) for discussions of this species.

Argia alberta Kennedy

19 Jun-6 Aug (15 records/13 counties)
 A western species at the edge of its range in the western Iowa.
 Rare (S2), tiny to small, rarely larger, streams, occasionally roadside ditches with flowing water.

Argia apicalis (Say)

27 May-1 Oct (623 records; 95 counties)
 An eastern species, expected in all our counties
 Common (S5), streams, creeks, and rivers, also lakes and large deep ponds; the state's most common *Argia*.

Argia emma Kennedy NO MAP

23 Jun (1 record/1 county)
 A western species at the edge of its range in western Iowa, possibly disjunct from populations in western Nebraska and western South Dakota.
 Extremely rare (S1), known only from a small creek in Crawford County.

Argia fumipennis violacea (Hagen)

27 May-27 Sep (187 records/58 counties)
 An eastern species, found throughout Iowa.
 Common (S4), streams, marshy edges of ponds and lakes, and marshy wetlands.

Argia moesta (Hagen)

27 May-1 Oct (164 records/50 counties)
 More or less nation-wide, rare, possibly absent in western and northwestern Iowa where it may be at the northern edge of its range.
 Uncommon-common (S3S4), mostly sandy-bottomed creeks and rivers, rarely streams or lakes.

Argia plana Calvert

6 Jun-9 Sep (78 records/43 counties)
A Mexican/southwestern species, state wide, relatively rare in southern Iowa.
Uncommon (S3), streams, rarely small creeks, usually associated with rocky riffles.

Argia tibialis (Rambur)

27 May-14 Sep (128 records/59 counties)
Primarily an eastern species, state wide.
Uncommon-common (S3S4), creeks and rivers, usually associated with snags and sand/gravel bars.

Coenagrion angulatum Walker

12 Jun-23 Jun (7 records/5 counties)
A species of the northern plains, whose range extends southward into western Iowa and South Dakota.
Rare (S2), ponds and ephemeral wetlands; an early season species.

Coenagrion resolutum (Sclys)

6 Jun-23 Jun (37 records/17 counties)
Primarily a northern species at the southern edge of its range in central Iowa.
Rare-uncommon (S2S3), ponds and ephemeral wetlands, an early season species.

Enallagma anna Williamson

31 May-17 Sep (226 records/76 counties)
A western species, statewide but relatively rare in southern Iowa.
Common (S4), streams and small creeks.

Enallagma antenatum (Say)

9 Jun-13 Sep (361 records/93 counties)
A northeastern species, state wide, expected in all counties.
Common (S5), streams, small creeks, ponds and small lakes.

Enallagma aspersum (Hagen)

16 May-17 Sep (116 records/48 counties)
Primarily an eastern species, statewide but apparently absent from northwest Iowa where it may be at edge of its range.
Uncommon-common (S3S4), wetlands, ponds.

Enallagma basidens Calvert

27 May-27 Sep (117 records/51 counties)
An eastern/southern species, state wide. Our first collection was on 6 Aug 1994 in Plymouth Co.
Uncommon-common (S3S4), primarily deep lakes in abandoned quarries, sand and gravel pits, rarely on streams.

Enallagma boreale Selys

17 Jun-19 Jul (3 records/2 counties)
Primarily a northern species, our collections are from northern Iowa.
Extremely rare (S1), wetlands. Possibly at the southern edge of its range in northern Iowa with populations in Missouri (Westfall and May 1996) being disjunct. There are no recent collections from Illinois (Cashatt and Vogt 1997).

Enallagma carunculatum Morse

27 May-15 Sep (315 records/85 counties)
Nation wide, statewide, probably occurs in all 99 counties.
Common (S5), ponds and lakes.

Enallagma civile (Hagen) NO MAP

16 May-17 Oct (826 records/all 99 counties)
Nation wide, state wide.
Common (S5), wetlands, ponds, and lakes, also slow flowing streams and small creeks. The state's most common *Enallagma*.

Enallagma clausum Morse

17 Jun-10 Aug (15 records/4 counties)
Primarily a western species at the edge of its range in northwest Iowa.
Rare (S2), natural lakes and pit ponds with little vegetation near the shore.

Enallagma cyathigerum (Charpentier)

31 May-29 Aug (86 records/38 counties)
Primarily a northern species, possibly at the edge of its range in southern Iowa.
Uncommon (S3), ponds, marshes and other wetlands.

Enallagma ebrium (Hagen)

7 Jun-3 Sep (64 records/20 counties)
Primarily a northern species, possibly at the southern edge of its range across central Iowa.
Uncommon (S3), permanent ponds and small lakes.

Enallagma exsulans (Hagen)

27 May-17 Sep (151 records/56 counties)
Primarily an eastern species, state wide.
Uncommon-common (S3S4), ponds, small lakes, creeks and rarely streams.

Enallagma geminatum Kellicott

15 May-30 Sep (265 records/79 counties)
Primarily an eastern species, state wide, to be expected in most counties.
Common (S4), lakes and deeper ponds.

Enallagma hageni (Walsh)

2 Jun-3 Sep (541 records/79 counties)
 A northern/northeastern species, state wide, to be expected in most counties.
 Common (S5), lakes, ponds and marshes.

Enallagma signatum (Hagen)
 22 May-11 Oct (234 records/72 counties)
 An eastern species, state wide, to be expected in most counties.
 Common (S4), lakes and deeper ponds.

Enallagma traviatum Selys
 20 Jun-4 Aug (43 records/26 counties)
 An eastern species at the western edge of its range in Iowa.
 Uncommon (S3), ponds, margins of lakes.

Enallagma vesperum Calvert
 1 Jun-15 Sep (7 records/7 counties)
 An eastern species, possibly at the edge of its range in Iowa. Our collections are from northwest and southeast Iowa.
 Rare (S2), deeper ponds and lakes. This species is easily missed due to its crepuscular habits.

Ischnura hastata (Say)
 16 Jun-27 Sep (26 records/20 counties)
 Primarily an eastern species, more or less state wide, possibly at edge of range in western Iowa.
 Rare-uncommon (S2S3), wetlands, margins of ponds, associated with stands of *Eleocharis*. Easily overlooked by collectors.

Ischnura posita (Hagen)
 15 May-11 Oct (113 records/35 counties)
 An eastern and southern species, possibly at edge of its range in Iowa.
 Uncommon-common (S3S4), wetlands, ponds, and lakes, occasionally in streams or small creeks.

Ischnura verticalis (Say) NO MAP
 9 May-17 Oct (1644 records/all 99 counties)
 An eastern species, state wide.
 Common (S5), wetlands, ponds, lakes, streams and creeks. Iowa's most common and widespread odonate. Teneral observed 13 April 2000.

Nehalennia irene (Hagen)
 6 Jun-7 Aug (98 records/32 counties)
 Primarily a northern species, possibly at the edge of its range in southern Iowa. More common in the northern half of the state.
 Uncommon (S3), ephemeral wetlands and ponds.

AESHNIDAE

Aeshna canadensis Walker
 3 Sep-5 Oct (8 records/6 counties)
 Primarily a northern/northeastern species, recent collections are from the eastern half of Iowa (see discussion of *A. clepsydra*).
 Rare (S2), marshy wetlands, and marshy edges of ponds. This is a late season species.

Aeshna constricta Say
 22 Jul-17 Oct (92 records/41 counties)
 A transcontinental species, more or less state wide. Records from the southern two tiers of counties may be based on post-reproductive individuals.
 Uncommon (S3), wetlands, ponds.

Aeshna interrupta lineata (Walker)
 12 Jul-19 Sep (14 records/8 counties)
 Northern Great Plains, primarily northwestern Iowa. It is at the southern limits of its range in Iowa.
 Rare (S2), ponds, lakes, streams and creeks. We have not seen this species mating or ovipositing.

Aeshna multicolor Hagen
 19 Jun-6 Sep (10 records/8 counties)
 A western species, scattered localities in the western half of the state where it is at the eastern edge of its range, and a single record from eastern Iowa.
 Rare (S2), primarily ponds and small lakes, one record from a creek.

Aeshna mutata Hagen NO MAP
 20 May-3 Jun (2 records/1 county)
 A northeastern species at the western edge of its range in Lee County in southeast Iowa.
 Extremely rare (S1), collections made in a field adjacent to a stream by Jim Durbin. Specimens were observed feeding. First report for Iowa.

Aeshna tuberculifera Walker NO MAP
 22 Aug (1 record/1 county)
 A northeastern species at the southwest corner of its range in Allamakee County in northeast Iowa.
 Extremely rare (S1), collection made in an open campground adjacent to a creek. Specimens collected were part of a feeding swarm. Probably a late season species.

Aeshna umbrosa Walker
 23 Jul-5 Oct (83 records/57 counties)
 A northern/eastern species, state wide but uncommon in southern Iowa, to be expected in most counties.
 Common (S4), streams and small creeks. A late season species.

Aeshna verticalis Hagen

5 Oct-11 Oct (4 records/4 counties).

A northeastern species at the western edge of its range in eastern Iowa.

Extremely rare (S1), wetlands, marshes and ponds.

A late season species whose range may have contracted during the past century. The record from Dickinson County is questionable (see Historic Record).

Anax junius (Drury) NO MAP

4 Apr-18 Oct (812 records/all 99 counties)

A transcontinental species, throughout the state.

Very common (S5), wetlands, ponds, and lakes.

This is Iowa's most common Aeshnid and the earliest species to appear.

Boyeria vinosa (Say)

6 Jul-12 Oct (164 records/62 counties)

An eastern species, throughout the state, to be expected in most counties.

Common (S4), creeks and smaller rivers, rarely streams, frequently found in shaded portions.

Usually seen next to the bank and about snags.

Epiaeschna heros (Fabricius) NO MAP

24 Apr-31 May

An eastern species at the western edge of its range in Iowa.

Extremely rare (S1), a specimen in the ISU collection was collected in Ames in Story County on 31 May 1988. The only other collections of this species were made by Whedon in Johnson County in 1908 (Whedon 1912).

Nasiaeschna pentacantha (Rambur)

15 Jun-10 Jul (4 records/4 counties)

An eastern species, our collections mark the northwest corner of its range, which may have contracted in the past century.

Extremely rare (S1), we collected it on shaded creeks and shaded arms of large, man-made lakes.

GOMPHIDAE

Arigomphus cornutus (Tough)

28 May-2 Aug (27 records/21 counties)

Northern Great Plains and Mid-west, scattered localities across the state, primarily in the northern half of the state. Possibly at southern edge of range in southern Iowa.

Rare-uncommon (S2S3), ponds and small lakes.

Arigomphus submedianus (Williamson)

27 May-1 Sep (126 records/53 counties)

Primarily a mid-continental species at the northern limit of its range across northern Iowa.

Common (S4), ponds and lakes.

Dromogomphus spoliatus (Hagen in Selys)

27 Jun-15 Sep (27 records/14 counties)

Primarily a mid-continental species, possibly at northern edge of range in southeastern Iowa.

Rare-uncommon (S2S3), man-made ponds and lakes.

Gomphus (Gomphurus) externus Hagen in Selys

22 May-6 Sep (134 records/65 counties)

Primarily a mid-continental species, state wide.

Common (S4), large streams, creeks, rarely smaller rivers, but frequently encountered along the Mississippi River.

Gomphus (Gomphurus) fraternus Say

10 Jun-8 Aug (32 records/15 counties)

An eastern species, at western edge of range in Iowa. The record from Dickinson County is questionable (see Historic Record).

Rare-uncommon (S2S3), primarily creeks and rivers.

Gomphus (Gomphurus) vastus Walsh

22 May-24 Jul (17 records/12 counties)

Primarily an eastern species, at edge of range in eastern Iowa.

Rare (S2), Mississippi, Cedar and Iowa Rivers.

Gomphus (Gomphus) graslinellus Walsh

27 May-8 Aug (49 records/26 counties)

A mid-continental species, probably state wide.

Uncommon (S3), streams and small lakes.

Gomphus (Gomphus) militaris Hagen in Selys

21 Jun-24 Jun (3 records/2 counties)

A south-central species, at north-eastern corner of range in southwest Iowa. Probably elsewhere in southwestern Iowa.

Extremely rare (S1), man-made ponds and lakes.

Gomphus (Gomphus) quadricolor Walsh NO MAP

17 Jun-24 Jun (2 records/1 county)

Primarily a northeastern species, at western edge of range in northeast Iowa (Fayette County).

Extremely rare (S1), rocky bottomed streams and creeks. First Report for Iowa.

Ophiogomphus rupinsulensis (Walsh)

17 Jun-31 Jul (4 records/2 counties)

A northeastern species, at western edge of range in northeast Iowa. The type locality, Rock Island, Illinois, is on the Iowa border.
Extremely rare (S1), sandy/rocky bottomed creeks.

Ophiogomphus sp.

14 Jun-1 Jul (4 records/3 counties)
Endemic to Wisconsin and eastern Iowa, streams and creeks in Benton, Black Hawk, and Buchanan counties.

Extremely rare (S1), sandy bottomed streams and creeks. This species is to be named in honor of William Smith of the Wisconsin DNR (Tennessee and Vogt pers. comm.). The Iowa records probably represent three populations. Reported from a number of sites in Wisconsin (Smith pers. comm.).

Progomphus obscurus (Rambur)

6 Jun-12 Sep (85 records/31 counties)
A southern transcontinental species, at edge of range across central Iowa.
Common (S4), sandy bottomed streams, creeks, and small rivers.

Stylurus amnicola (Walsh)

20 Jun-14 Sep (43 records/28 counties)
Primarily an eastern species, more or less state wide.
Uncommon (S3), sandy bottomed creeks and small rivers.

Stylurus intricatus (Hagen in Selys)

24 Jul-15 Sep (2 records/2 counties)
A southwestern species at northeastern edge of its range in western Iowa.
Extremely rare (S1), sandy bottomed creeks and rivers.

Stylurus notatus (Rambur)

10 Jun-12 Sep (51 records/33 counties)
An eastern species, more or less state wide.
Uncommon (S3), sandy bottomed creeks and rivers, only rarely on a stream.

Stylurus plagiatus (Selys)

30 Jun-17 Oct (56 records/28 counties)
An eastern species at northwestern edge of range in Iowa.
Uncommon (S3), sandy bottomed creeks and rivers.

Stylurus spiniceps (Walsh) NO MAP

8 Aug (1 record/1 county)
Primarily a northeastern species at western edge of range in Bremer County.

Extremely rare (S1), our single collection was made on a sandy bottomed river at about 6 PM. First Report for Iowa.

MACROMIIDAE

Macromia illinoiensis Walsh

7 Jul-12 Sep (23 records/14 counties)
Primarily an eastern species, our collections are from the eastern third of the state.
Rare-uncommon (S2S3), rocky and gravelly bottomed creeks and rivers.

Macromia taeniolata Rambur

10 Jul-5 Oct (10 records/8 counties)
Primarily an eastern species, most of our collections are from the Mississippi River, possibly at western edge of its range in Iowa. Individuals observed on large lakes in Decatur County probably belong to this species.
Rare (S2), large rivers, rarely large lakes.

CORDULIIDAE

Epitheca cynosura (Say)

15 May-14 Aug (315 records/94 counties)
An eastern species, state wide, anticipated to occur in all 99 counties.
Common (S4), lakes and ponds.

Epitheca princeps (Hagen)

1 Jun-15 Sep (391 records/91 counties)
An eastern species, state wide, expected in all 99 counties.
Common (S4), lakes and large ponds, also along Mississippi River.

Neurocordulia molesta (Walsh)

28 May-3 Jul (records: see below)
Primarily a mid-continental species, scattered localities state wide. Possibly at northern edge of range in Iowa.
Rare (S2), large rivers, including the Mississippi, Des Moines, Boone, and Iowa. Known from larvae and exuviae collected in Allamakee and Clayton Counties (W. Smith pers. comm.), Monona County (State Hygenics Lab) and Polk County (Tod Hubbard)(identified by RWC), and adults collected in Johnson (Mary Gode, 28 May 1998), Boone (ISU collection, 11 June 1988) and Allamakee Counties (W. Smith, pers. commun.).

Neurocordulia yamaskanensis Provancher NO MAP

6 Jun-3 Jul

Primarily a northeastern species, at edge of range in northeastern Iowa.

Extremely rare (S1), Mississippi River in Allamakee and Clayton Counties. Known only from adults and exuviae collected by W. Smith (Smith pers. comm.). First Report for Iowa.

Somatochlora ensigera Martin

17 Jul-6 Sep (32 records/18 counties)

Mostly the upper mid-west, northwest and central Iowa. Uncommon (S3), streams, rarely a small creek.

LIBELLULIDAE

Celithemis elisa (Hagen)

28 May-17 Sep (61 records/37 counties)

An eastern species, state wide.

Uncommon (S3), small deep lakes in quarries, gravel pits, etc.

Celithemis eponina (Drury)

21 Jun-17 Sep (195 records/77 counties)

An eastern species, state wide, to be expected in all 99 counties.

Common (S4), ponds and small lakes.

Erythemis simplicicollis (Say) NO MAP

27 May-11 Oct (637 records/all 99 counties)

A transcontinental species, state wide.

Common (S5), ponds, lakes and wetlands, frequently seen along streams and small creeks.

Leucorrhinia intacta (Hagen)

17 May-6 Aug (218 records/65 counties)

A northern transcontinental species, state wide, expected in most counties. Most of our records from late May to mid-July. Common (S4), ponds and small lakes.

Libellula cyanea Fabricius

8 Jun-2 Jul (3 records/3 counties)

An eastern/southern species, at northern edge of range in southern Iowa.

Extremely rare (S1), man-made ponds and lakes.

Libellula luctuosa Burmeister NO MAP

28 May-4 Oct (831 records/all 99 counties)

Primarily an eastern species, state wide.

Common (S5), wetlands, ponds, and lakes, occasionally streams and small creeks.

Libellula lydia Drury NO MAP

9 May-6 Oct (779 records/all 99 counties)

A transcontinental species, state wide.

Common (S5), ponds, lakes, occasionally streams and creeks.

Libellula pulchella Drury NO MAP

15 May-14 Sep (950 records/all 99 counties)

A transcontinental species, state wide.

Common (S5), ponds, lakes, occasionally streams and creeks.

Libellula quadrimaculata Linnaeus

11 Jun-17 Jul (17 records/9 counties)

A northern, transcontinental species, at southern edge of range in Iowa.

Rare (S2), marshes and woodland ponds.

Pachydiplax longipennis (Burmeister)

28 May-21 Sep (455 records/94 counties)

More or less transcontinental, state wide, expected in all 99 counties.

Common (S5), marshes, ponds and small lakes.

Pantala flavescens (Fabricius)

27 Jun-28 Sep (80 records/52 counties)

More or less transcontinental, state wide, may occur in all our counties.

Common (S4), creeks, wetlands and ponds, often seen foraging away from water of any type.

Pantala hymenaea (Say)

2 Jun-28 Sept (34 records/23 counties)

More or less transcontinental, state wide.

Uncommon (S3), usually close to ponds or wetlands.

Perithemis tenera (Say) NO MAP

27 May-1 Oct (593 records/97 counties)

An eastern species, state wide, expected in all 99 counties.

Common (S5), deeper ponds and lakes.

Sympetrum ambiguum (Rambur) NO MAP

22 Aug-6 Oct (2 records/1 county)

An eastern species, at western edge of range in Muscatine County in eastern Iowa.

Extremely rare (S1) ephemeral ponds and swales on the flood plain of the Cedar River. First Report for Iowa, collected in 1997 and again in 1999.

Sympetrum corruptum (Hagen)

10 Jun-4 Oct (74 records/34 counties)

A transcontinental species, state wide.

Uncommon (S3), wetlands, ponds and smaller lakes. Territorial males observed 22 April 2000.

Sympetrum costiferum (Hagen)

30 Jun-18 Oct (88 records/50 counties)

A northern transcontinental species, state wide.
Uncommon (S3), wetlands and ponds.

Sympetrum internum Montgomery

12 Jun-18 Oct (98 records/48 counties)

A northern transcontinental species, state wide,
probably in most counties.

Uncommon-common (S3S4), wetlands and ponds.

Sympetrum obtrusum (Hagen)

2 Jun-17 Oct (291 records/77 counties)

A northern transcontinental species, state wide,
probably in all 99 counties.

Common (S5), ponds and wetlands, occasionally
along streams.

Sympetrum occidentale fasciatum (Walker)

30 Jun-28 Sep (130 records/55 counties)

A subspecies of the northern Great Plains, state
wide, to be expected in most counties.

Uncommon-common (S3S4), marshes, wetlands,
streams, wet ditches, rarely ponds.

Sympetrum rubicundulum (Say)

30 May-19 Oct (347 records/90 counties)

More or less a transcontinental species, state wide,
probably in all counties.

Common (S5), wetlands, ponds and streams. Our
most common *Sympetrum*.

Sympetrum vicinum (Hagen)

1 Jul-19 Oct (93 records/46 counties)

Primarily an eastern species, probably state wide.

Uncommon (S3), wetlands and ponds.

Tramea carolina (Linnaeus) NO MAP

28 May-8 Jun (2 records/1 county)

An eastern species at western edge of range in
Mahaska County.

Extremely rare (S1), wetland. Collected in 1998
and again in 1999. The record from Cherokee
County (see Appendix) is suspect because
Whedon's (1912) illustration of the genitalia is that
of *T. onusta*. The Story County record is
questionable because Wells' specimens at ISU are
referable to *T. onusta*.

Tramea lacerata Hagen NO MAP

18 May-10 Oct (454 records/97 counties)

More or less transcontinental, state wide.

Common (S5), wetlands, ponds and small lakes.

Tramea onusta Hagen

27 May-17 Sep (57 records/40 counties)

A more or less transcontinental species, state wide,
probably in most counties.

Uncommon-common (S3S4), wetlands and ponds.

We observed red individuals in 25 other counties
(see Appendix) that probably were this species.

Rarely observed after July 31. However, we have
observed teneral individuals in September.

VAGRANT OR ACCIDENTAL SPECIES

Of the 128 species reported for the state at least two
were probably accidentals.

Erythrodiplax minuscula was reported from Cedar
County by Whedon (1912) as *Sympetrum
minusculum*. Illustrations of the genitalia leave
little doubt as to the identification of the species.

Tramea calverti was collected by Steven Hummel
in Allamakee County in August 1972 (Hummel
1999).

In the main list there is evidence that nearly all of
the extremely rare species have resident
populations (Table 1), most of which, are
reasonable extensions of the known distributional
ranges (but see account of *Argia emma*). Of the
extremely rare species that we collected only
Stylurus spiniceps is known from a single
individual. The collection site was typical for the
species.

POSSIBLY EXTIRPATED SPECIES

Lestes vigilax Hagen - This is reported from
Dickinson, Johnson (Whedon 1912), and Muscatine
counties (Wilson 1909), and is also listed by
Montgomery (1967) and Westfall and May (1997).
Whedon's illustrations do not provide evidence that
he collected this species. However, specimens of
this species would key out with reasonable ease in
his key to species. This species is rare in Illinois
and recent collections are from the northeast and
southwest counties.

Gomphus exilis Selys - The report of this species
was based on a female collected in Muscatine
County (Whedon 1912). It is reported as secure in
Illinois, where the nearest sites are in the central
part of the state.

Hagenius brevistylus Selys - Whedon (1912)
collected this species on the Iowa River in Hardin
County. It is listed as critically imperiled in Illinois,
and recent collections are from the southern half of
the state. It is relatively common in Wisconsin
(Smith et al. 1993).

EXCLUDED AND QUESTIONABLE SPECIES

Previously we excluded nine species from the state list (Cruden and Gode 1998). Four species were unlikely to have occurred or been established in the state, i.e., *Aeshna palmata* Hagen, *Neurocordulia obsoleta* Say, *Sympetrum madidum* Hagen, and *Enallagma recurvatum* Davis. Five species, i.e., *Argomphus pallidus* (Rambur), *Gomphus ventricosus* Walsh, *Sympetrum semicinctum* (Say), *Hetaerina tricolor* (Burmeister), and *Argia vivida* Hagen, were excluded because they were synonyms, based on misidentified specimens, or the result of other mistakes.

We did not collect 14 other species reported by earlier workers. With the exception of *Macromia pacifica*, it is highly unlikely that any of the following species were established in Iowa. In the following accounts all references to a species status and distribution in Illinois are based on information provided by Cashatt and Vogt (1997).

Aeshna clepsydra Say - This species was reported from Cherokee, Dickinson (Whedon 1912), and Des Moines Counties (Wilson 1909), and listed by Needham et al (2000). A Wilson specimen from Des Moines County, i.e., Burlington, originally identified as *A. clepsydra* was identified by Currie as *A. interrupta lineata* (Flint pers. comm.). Whedon's determinations are suspect because he collected two species and only after careful examination did he identify some of the material as this species, rather than *A. verticalis*. The two species should be easily separated on the basis of thoracic color patterns. However, *A. verticalis* and *A. canadensis* are difficult to separate, and the traits Whedon used to separate *A. clepsydra* and *A. verticalis* also serve to separate *A. verticalis* and *A. canadensis*, thus it seems likely that Whedon actually had *A. canadensis* rather than *A. clepsydra* (also see Cruden and Gode 1998). It is possible that Whedon was unaware of the description of *A. canadensis* (see Walker 1912). There are old records of *A. clepsydra* from northeastern Illinois and eastern Wisconsin (Smith et al. 1993).

Basiaeschna janata (Say) - Wells (1917) reported this species from Muscatine County based on material in Wilson's collection but Wilson (1921) did not discuss this species. We found no material of this species in the collection at ISU. It was listed by both Montgomery (1967) and Needham et al (2000). This species is listed as imperiled (S2) in Illinois but may be fairly common in Wisconsin

(Legler et al. 1996; Smith et al. 1993). It would be at the western edge of its range in Iowa.

Argomphus furcifer (Hagen) - This species was listed by Montgomery (1967) and Needham et al (2000). The type material of *Gomphus whedoni* Muttkowski is very similar to specimens of *Argomphus cornutus* (Susan Borkin, pers. comm.), and Needham and Westfall listed *G. whedoni* as a synonym of *A. cornutus*. However, the illustration of the superior appendages of *Gomphus whedoni* Mutt. in Whedon (1912) appears to be those of *A. furcifer* rather than *A. cornutus*. Reports of *A. furcifer* from Henry County (Hoffman 1924) and Story County (Wells 1917) were based on misidentified specimens of *A. cornutus*. There are no recent collections of *A. furcifer* from Illinois but it occurs locally throughout Wisconsin (Smith et al. 1993).

Gomphus crassus Hagen - Wells (1917) reported this species from Muscatine County. Wells cited Wilson but Wilson (1921) did not discuss it. It also was listed by Montgomery (1967) and Needham et al (2000), but the latter listed it as questionable in Illinois and it has not been reported from Wisconsin (Smith

et al. 1993). This species has not been reported from Illinois or Wisconsin (Smith et al. 1993) and would have been at the western edge of its distributional range in Iowa.

Gomphus descriptus Banks - Wilson's (1909) report was based on two females collected on rocks near the Mississippi River at Burlington in Des Moines County. This species was listed from Iowa by Montgomery (1967) but was not listed from either Iowa or Illinois by Needham et al. (2000). Based on the available evidence this species should be excluded from the state list.

Macromia pacifica Hagen - A nymph collected in Buchanan County in 1999 was identified as this species (Smith pers. comm.). This mid-continental species occurred in both Wisconsin and Illinois, but there are no recent collections from Illinois. The identification should be verified before placing it on the state list.

Epithea spinigera Selys - Reported by Loudon (1933) based on material at the University of Iowa. However, Whedon did not include this species in his thesis. It occurred in and around St. Paul in southeastern Minnesota (Wilson 1909) and there are old records from Illinois. Today it does not occur in southwestern Wisconsin (Legler et al.

1996; Smith et al. 1993). It was listed by Needham et al. (2000) as occurring in Iowa. It would have been at western edge of its distributional range in Iowa.

Neurocordulia xanthosoma (Williamson) - This species was listed by Montgomery (1967) and Needham et al (2000). It is critically imperiled in Illinois, where the only recent collection is from Pope County in the southeast corner of the state. This is consistent with a distributional range that extends from Texas north into Missouri and southern Illinois.

Somatochlora linearis (Hagen) - Loudon (1933) reported this species at Iowa State College and it was listed by Needham et al. (2000). A female specimen in the ISU collection was identified by Montgomery as *S. ensigera*. This specimen was collected by Wells in Ames, IA, 21 July 1916 and also bears a label inscribed *S. linearis*. The latter label is considered to be the basis for Loudon's report. This specimen also is the source for the report of *S. tenebrosa* (see below). *S. linearis* is reported from Missouri and Illinois but not from Wisconsin. It is rare to uncommon in Illinois with recent collections from Cook County in the northeast corner of the state and the southern third of the state.

Somatochlora tenebrosa (Say) - Wells (1917) reported this eastern species from Story County and it was listed by Montgomery (1967) and Needham et al (2000). The only specimen of *Somatochlora* in the collection at ISU is the female *linearis* discussed above. The specimen bears the same collection data that accompanied Wells (1917) report of *S. tenebrosa*. This species is imperiled in Illinois where the only recent collection is from the southeast corner of the state. It would have been at the northwestern edge of its distributional range in Iowa.

Sympetrum danae (Sulzer) - This species was listed by Montgomery (1967) and Needham et al (2000). The report from Illinois is not persuasive. This boreal species reaches northern and eastern Wisconsin (Ries 1967; Smith, et al. 1993).

FUTURE WORK

Our knowledge of the state's Odonata is still imperfect. General collecting needs to be done in southwest and western Iowa. We collected approximately 34 (range 30-37) species per county (n=12) in southwest Iowa compared to 42 (range

30-63) species per county elsewhere in Iowa. The lower species diversity we observed in southwest and western Iowa may be an artifact of insufficient collecting, low habitat diversity and/or an accident of biogeography. This region harbors few wetlands and many, if not most, of the creeks and rivers have been straightened. The farm ponds and lakes are relatively uniform and do not support a rich biota. Further, many eastern and/or boreal species do not reach this part of Iowa. The recent discovery of *Stylurus intricatus* on the E. Nishnabotna River in conjunction with the earlier collection of *Argia emma* suggests that the streams, creeks and rivers of western Iowa merit careful and intensive exploration. More collecting needs to be done in northern Iowa to determine the status of species that are restricted to wetlands, e.g., *Enallagma boreale* and various *Aeshna*. The streams and creeks of the Paleozoic Plateau may be home to species that occur in adjacent southwest Wisconsin, e.g., *Cordulegaster maculata*, *Basiaeschna janata*, and *Didymops transversa*. Also, the streams, creeks and rivers of the Paleozoic Plateau and Iowan Surface need additional study to better determine the status of imperiled *Gomphus*, *Ophiogomphus*, and *Stylurus*. For example, are *G. quadricolor* and *O. rupinsulensis* restricted to rocky bottomed creeks and small rivers of the Iowan Surface adjacent to the Paleozoic Plateau. Further, the discovery of *Gomphus quadricolor* in 1999 suggests the possibility that the creeks and rivers of northeast Iowa might harbor other rare gomphids. Finally, a careful examination of the material Wilson (1909) collected on the Pearl Mussel Survey should clarify whether several species were present in the state early in the last century. Likewise, the discovery and examination of Whedon's (1912) material, if extant, would contribute to our understanding of what species were in Iowa early in the last century.

ACKNOWLEDGEMENTS

We thank William Smith (Wisconsin DNR), Susan Borkin (Milwaukee Public Museum), and Karl and Dorothy Legler for providing information on species that occur in southwestern Wisconsin. William Smith also provided information on *Neurocordulia yamaskanensis* and other species. Jim Durbin collected and provided information on *Aeshna mutata*. Susan Borkin also provided information on the type of *Arigomphus whedoni*. Nancy Adams and Oliver Flint provided information on specimens in the National Museum of Natural History. Steven Hummel and Ann Johnson provided unpublished records. Kristina

Baker, John McLure, and Matt Beisel aided in the field work. John Crooks provided access to Hoffman's material at Iowa Wesleyan College. Our thanks to Nick Donnelly examined our material of *Lestes disjunctus* and *L. forcipatus* and for editing the manuscript. We thank Jean Prior for her critique of the section on Iowa Landforms and permission to adapt figures 1 and 2 for this paper. Figures 1 and 2 were prepared by Shelley Plattner. Numerous friends at Iowa Lakeside Laboratory provided encouragement throughout the study. Field work was supported, in part, by grants ISF-94-17, ISF-95-28, and ISF-96-33 from the Iowa Science Foundation.

LITERATURE CITED

- Baker, R. 1996. Runoff on Cayler Prairie. Page 32. In Okoboji Wetlands- A lesson in natural history. Lannoo, M. J. University of Iowa Press, Iowa City.
- Bick, G. H., J. C. Bick and L. Hornuff. 1977. An annotated list of the Odonata of the Dakotas. Florida Entomol. 60:149-165.
- Bishop, R. A., J. Joens, and J. Zohrer. 1998. Iowa's wetlands, present and future with a focus on prairie potholes. Jour. Iowa Acad. Sci. 105:89-93.
- Calvin, S. 1901. Geology of Page County. Iowa Geological Survey. Annual Report. 11:399-460.
- Cashatt, E. and T. E. Vogt. 1997. Checklist and status of Illinois dragonflies (Odonata: Anisoptera). Research and Collection Center, Illinois State Museum, Springfield, IL. 62704. <http://www.museum.state.il.us/research/entomology/df1list.html>
- Cruden, R. W., and O. J. Gode, Jr. 1998. Iowa's Odonata: Declining and/or Changing? Jour. Iowa Academy Science 105:67-81.
- Donnelly, N. 2000. Dot-map project - Hung up on *Lestes!* ARGIA 12(3):31-32.
- Elrod, M. J. 1898. Iowan Odonata. Entomol. News. 9:7-10.
- Glotzhober, R. C. 1995. The Odonata of Ohio - A preliminary report. Bull. Amer. Odonatology 3:1-30.
- Hoffman, C. 1924. Odonata (Dragon-flies and Damsel-flies) of Henry County. Proc. Iowa Acad. Sci. 31: 441-442.
- Hummel, M. S. 1978. A checklist of the Odonata of Dickinson County, Iowa. Cordulia 4: 127-128.
- Hummel, M. S. 1999. A twenty-six year old record for *Tramea calverti* in Iowa. ARGIA 11(1):29.
- Hummel, M. S. and A. C. Haman. 1975. Notes on the Odonata of Black Hawk County, Iowa. Entomol. News 86: 63-64.
- Hummel, M. S. and A. C. Haman. 1977. Notes on the Odonata of the Cedar-Iowa River Basin. Proc. Iowa Acad. Sci. 84:110-118.
- Legler, K., D. Legler, and D. Westover. 1996. Guide to the common Dragonflies of Wisconsin. Published Privately, Sauk City, Wisconsin.
- Loudon, D. 1933. Comparative list of the Odonata know to occur in Iowa. Proceedings of the Iowa Academy of Science 40:213-215.
- Miller, N. 1906. Some notes on the dragonflies of Waterloo, Iowa. Entomol. News. 17:357-361.
- Montgomery, B. E. 1967. Geographical distribution of the Odonata of the north central states. Proc. North Central Branch Entomol.
- Needham, J. G., M. J. Westfall, Jr., and May, Michael L. 2000. Dragonflies of North America (Anisoptera), revised edition. Scientific Publishers, Gainesville, Florida, 939 pp. + 14 pl.
- Prior, J. C. 1991. Landforms of Iowa. University of Iowa Press, Iowa City.
- Ries, M. 1967. Present state of knowledge of the distribution of Odonata in Wisconsin. Proc. North Central Branch Entomol. Soc. Amer. 22:113-115.
- Smith, D. D. 1998. Iowa prairie: Original extent and loss, preservation and recovery attempts. Jour. Iowa Acad. Sci. 105:94-108.
- Tennessee, K. J., J. D. Harper, and R. S. Krotzer. 1995. The distribution of Odonata in Alabama. Bull. Amer. Odonatology

3:49-74.

Whedon, A. D. 1912. The Odonata of Iowa. M.Sc. Thesis, University of Iowa. Iowa City, Iowa.

Walker, E. M. 1912. The North American dragonflies of the genus *Aeshna*. Univ. Toronto Studies, Biol. Ser. No. 11:1-213.

Wilson, C. B. 1909. Dragonflies of the Mississippi Valley collected during the pearl mussel investigation on the Mississippi River, July and August, 1907. Proc. U.S. Nat. Mus. 36:653-671.

Walker, E. M. 1958. The Odonata of Canada and Alaska. Vol. 2. University of Toronto Press. Toronto.

Wilson, C. B. 1921. Dragonflies and damselflies in relation to pondfish culture, with a list of those found near Fairport, Iowa. Bull. U.S. Bureau of Fisheries. 36:185-259.

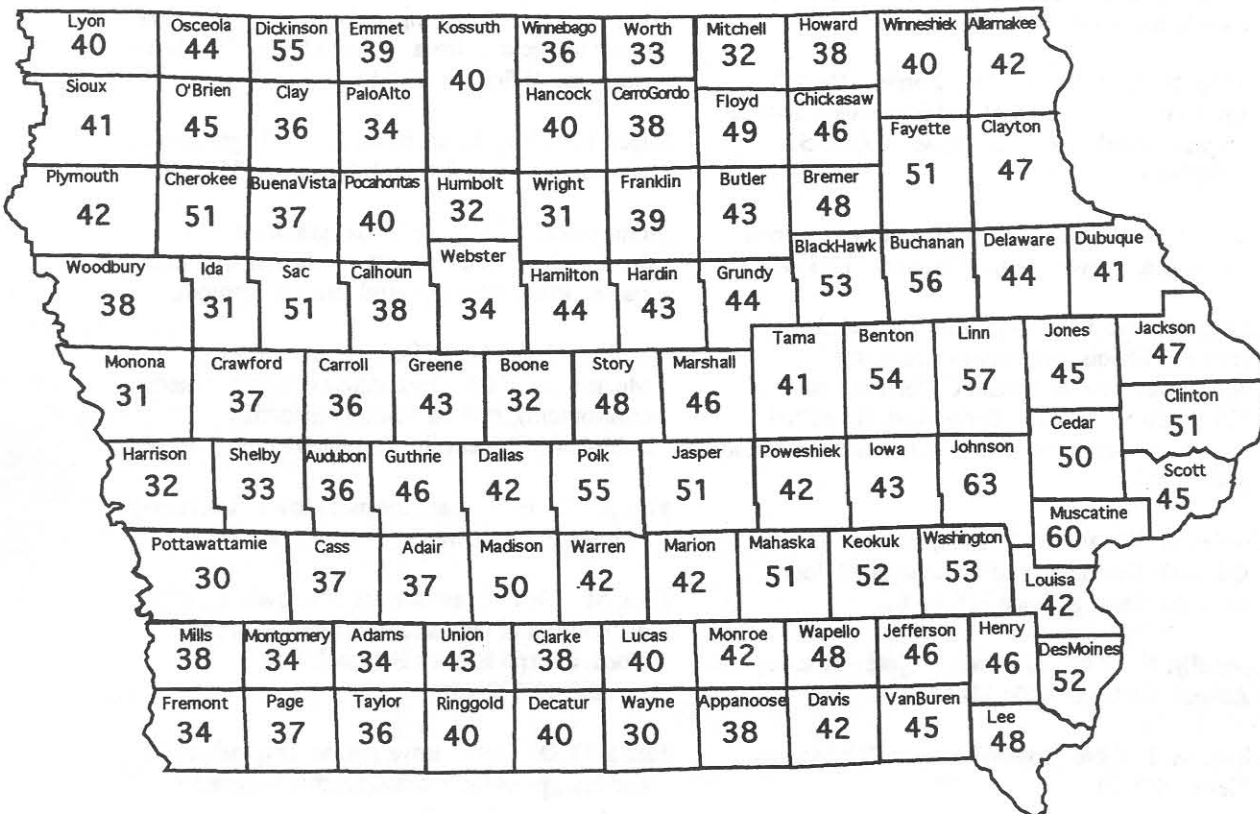
Wells, L. 1917. Odonata of Iowa. Proc. Iowa Acad. Sci. 24:327-333.

Yeager, W. C. 1932. Some dragonflies of northwest Iowa. Proc. Iowa Acad. Sci. 39:261-263.

Westfall, M. J., Jr. and M. L. May. 1996. Damselflies of North America. Scientific Publishers, Gainesville, Fl.



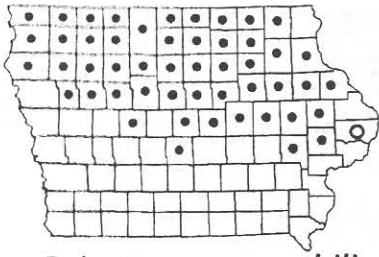
DISTRIBUTIONAL MAPS. The maps incorporate our records (solid circles) and records from the literature, specimens in various collections, and personal communications (open circles). Questionable records from the literature are not included but are indicated in the Appendix.



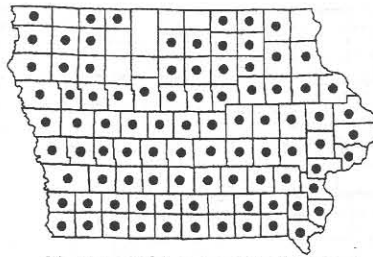
COUNTIES OF IOWA

Numbers indicate taxa recorded by the authors 1993-2000

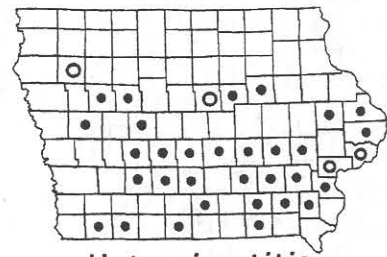
Fig. 3. Map of Iowa showing the number of species the authors collected in each county.



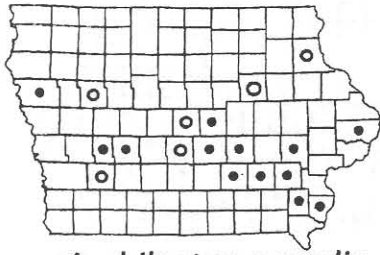
Calopteryx aquabilis



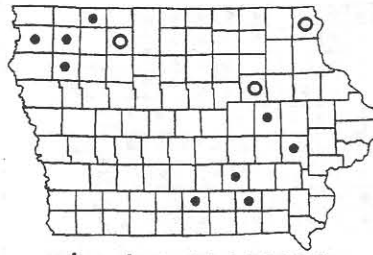
Hetaerina americana



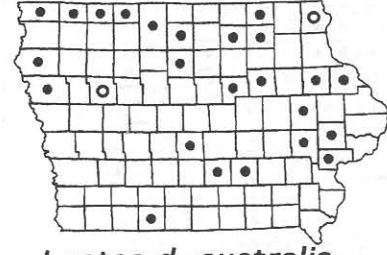
Hetaerina titia



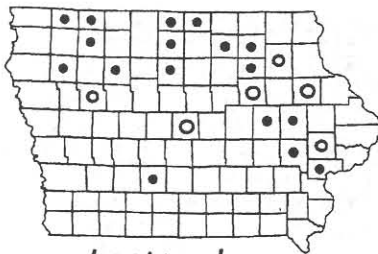
Archilestes grandis



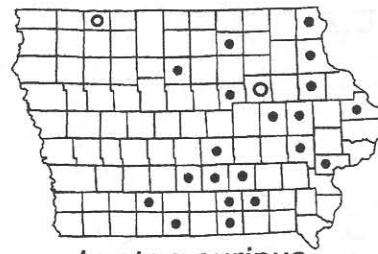
Lestes congener



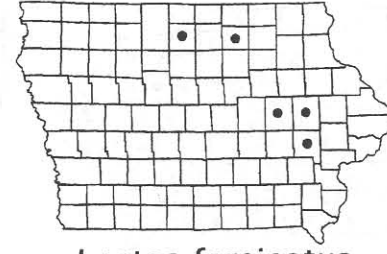
Lestes d. australis



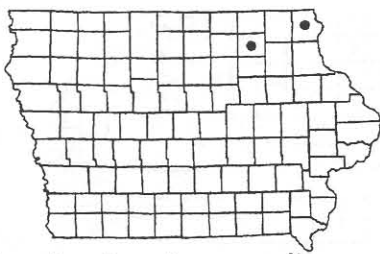
Lestes dryas



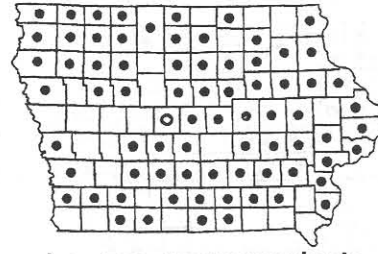
Lestes eurinus



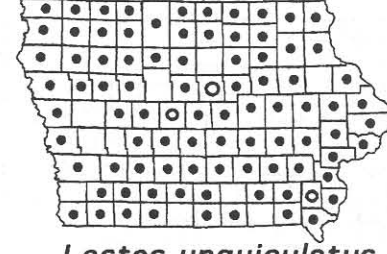
Lestes forcipatus



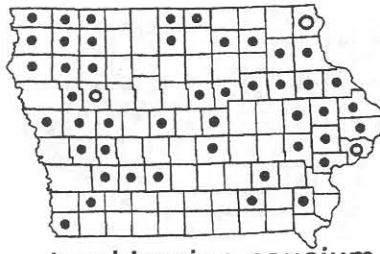
Lestes inaequalis



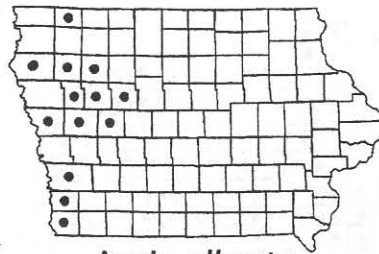
Lestes rectangularis



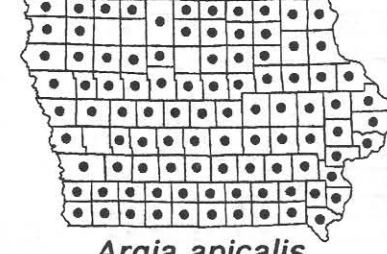
Lestes unguiculatus



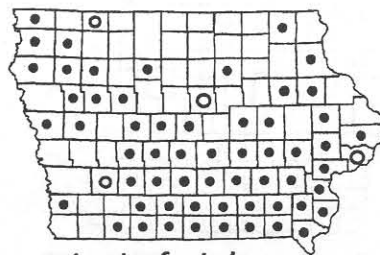
Amphigiagrion saucium



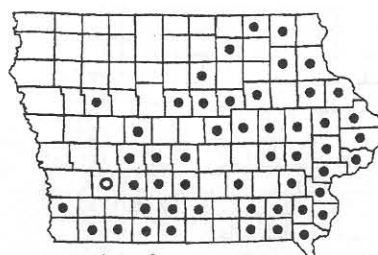
Argia albata



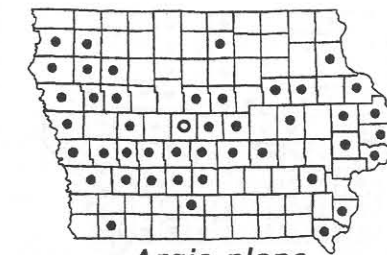
Argia apicalis



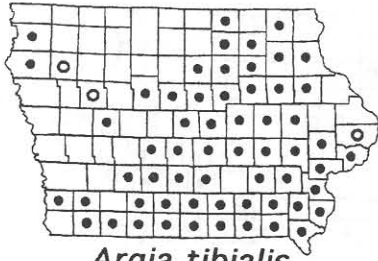
Argia f.violacea



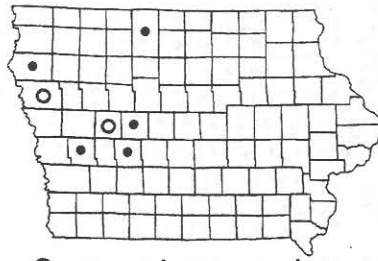
Argia moesta



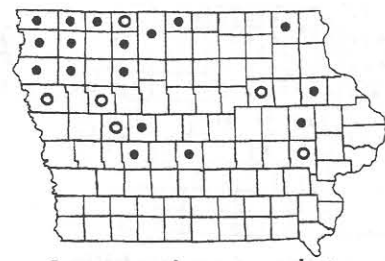
Argia plana



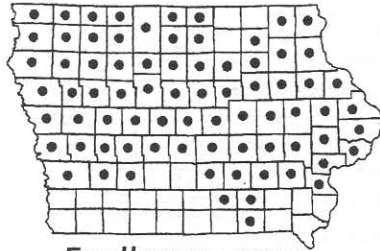
Argia tibialis



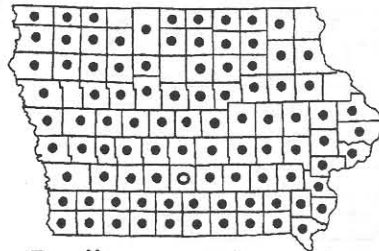
Coenagrion angulatum



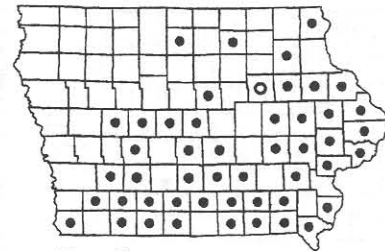
Coenagrion resolutum



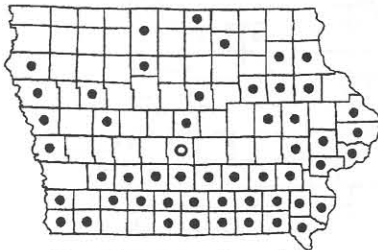
Enallagma anna



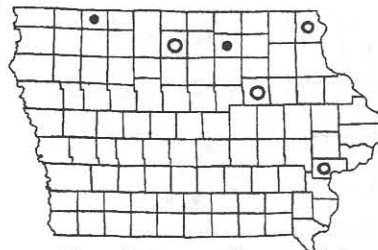
Enallagma antennatum



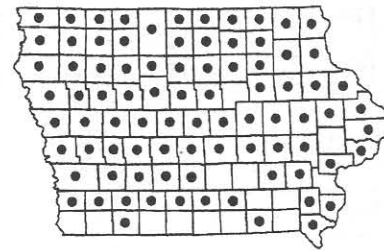
Enallagma aspersum



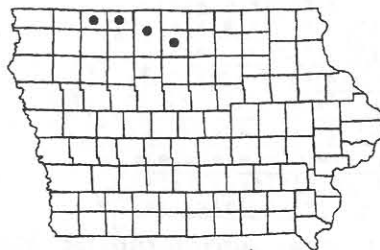
Enallagma basidens



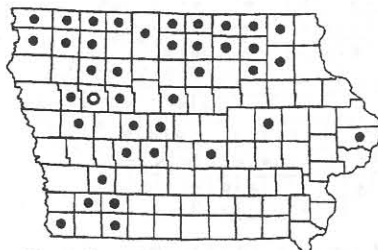
Enallagma boreale



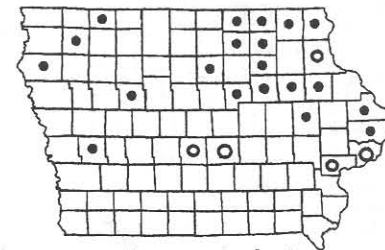
Enallagma carunculatum



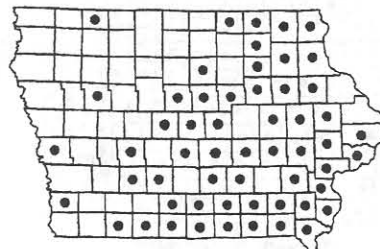
Enallagma clausum



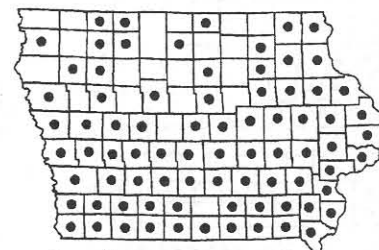
Enallagma cyathigerum



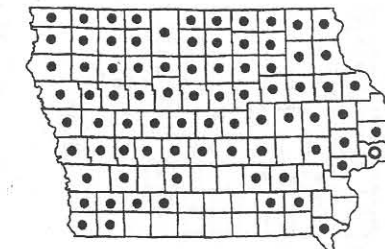
Enallagma ebrium



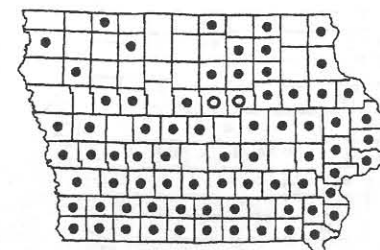
Enallagma exsulans



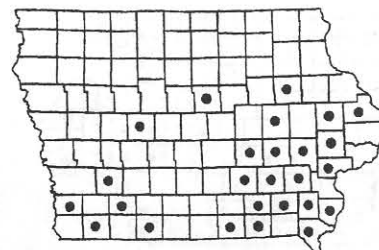
Enallagma geminatum



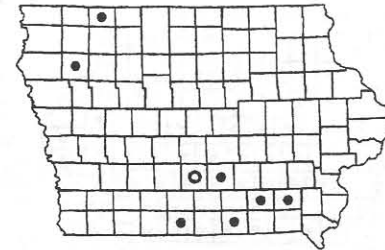
Enallagma hageni



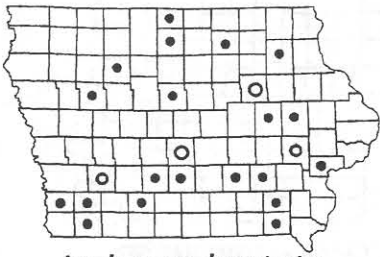
Enallagma signatum



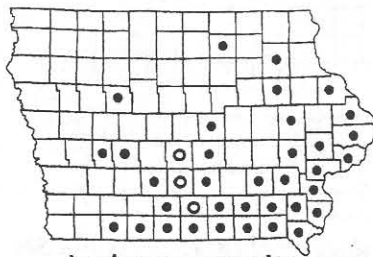
Enallagma traviatum



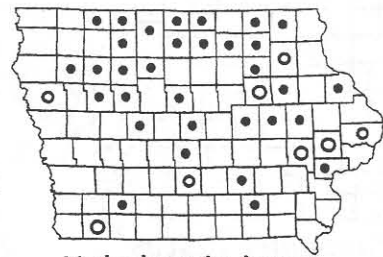
Enallagma vesperum



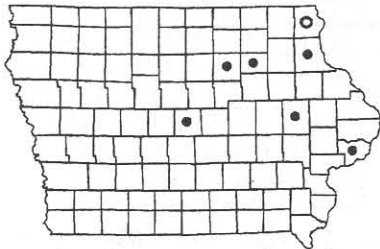
Ischnura hastata



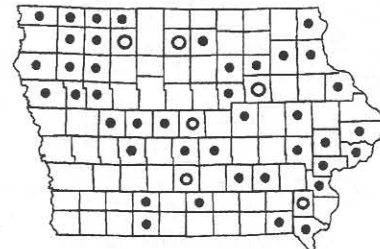
Ischnura posita



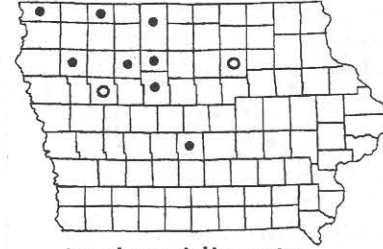
Nehalennia irene



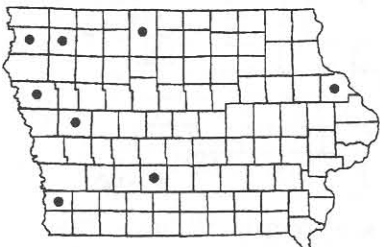
Aeshna canadensis



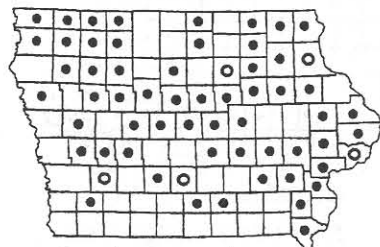
Aeshna constricta



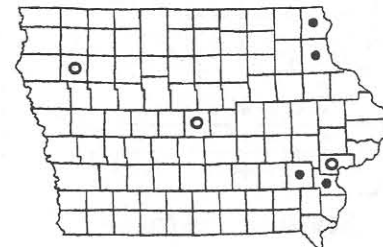
Aeshna i. lineata



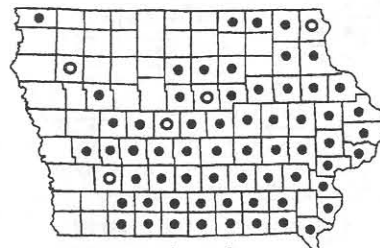
Aeshna multicolor



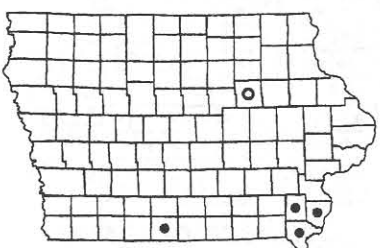
Aeshna umbrosa



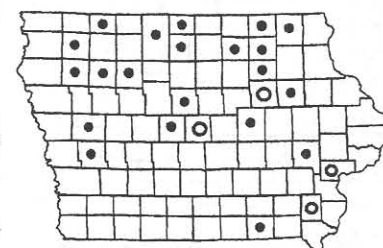
Aeshna verticalis



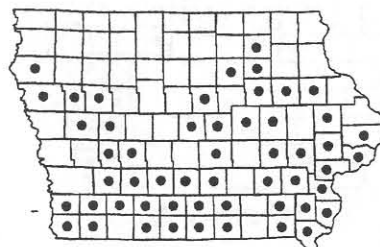
Boyeria vinosa



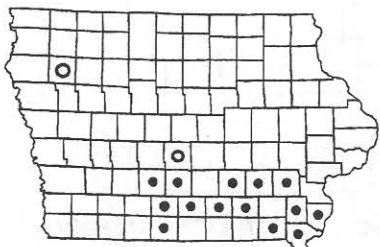
Nasiaeschna pentacantha



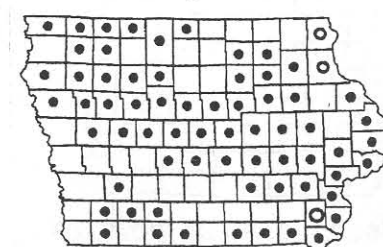
Arigomphus cornutus



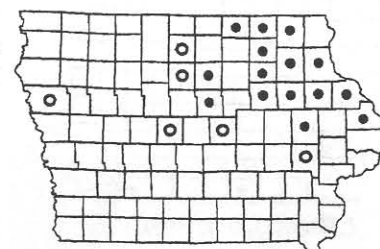
Arigomphus submedianus



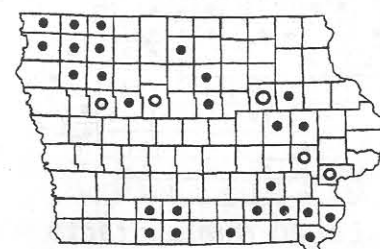
Dromogomphus spoliatus



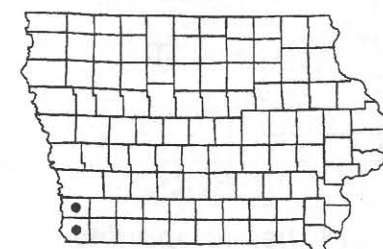
Gomphus externus



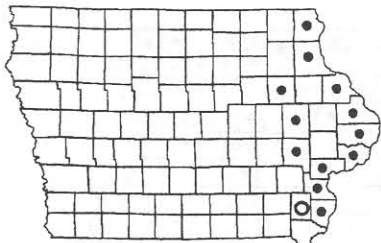
Gomphus fraternus



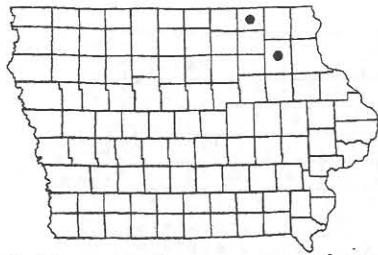
Gomphus graslinellus



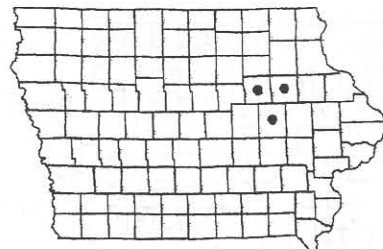
Gomphus militaris



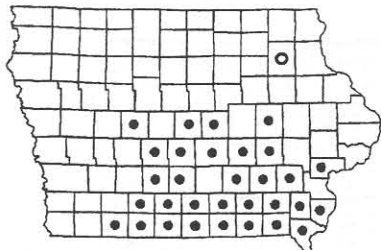
Gomphus vastus



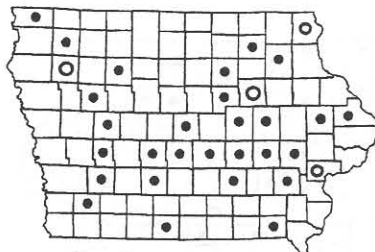
Ophiogomphus rupensulensis



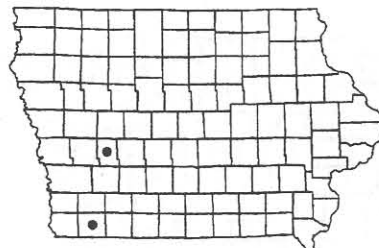
Ophiogomphus sp.



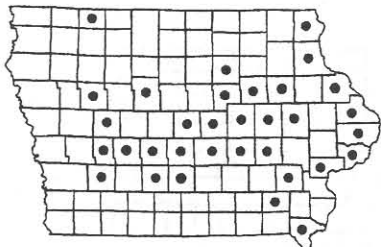
Progomphus obscurus



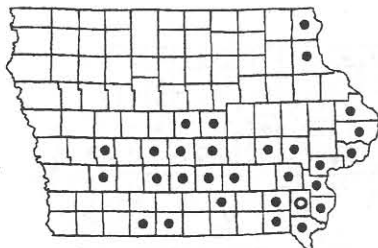
Stylurus amnicola



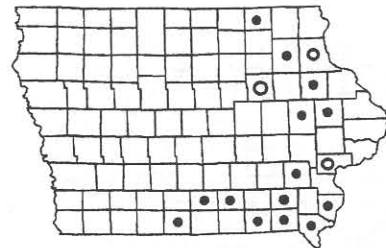
Stylurus intricatus



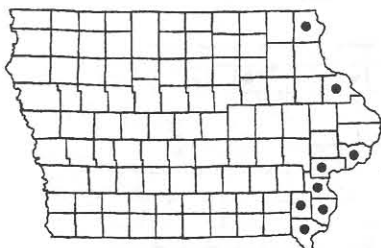
Stylurus notatus



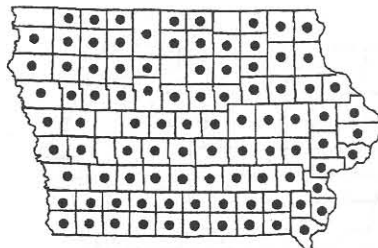
Stylurus plagiatus



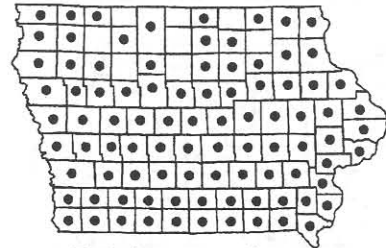
Macromia illinoiensis



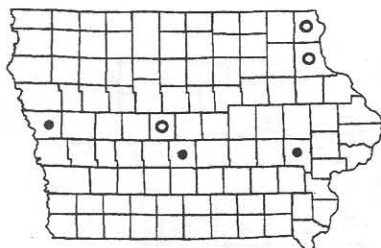
Macromia taeniolata



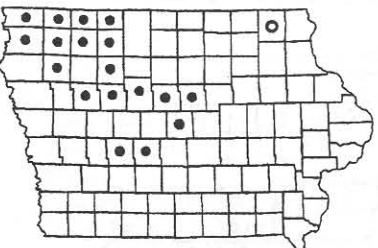
Epitheca cynosura



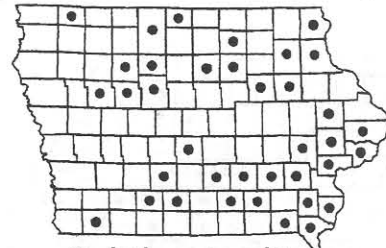
Epitheca princeps



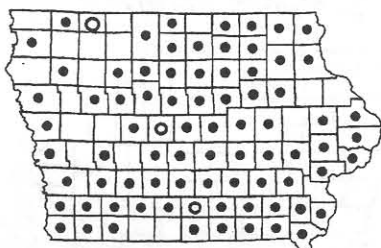
Neurocordulia molesta



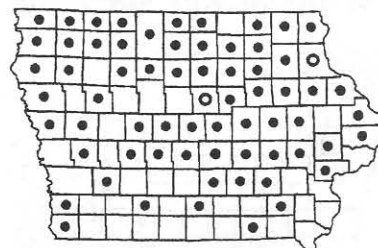
Somatachlora ensigera



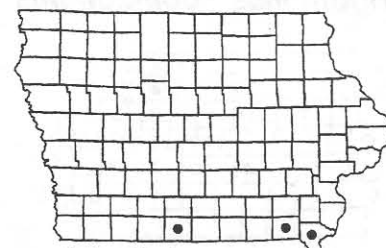
Celithemis elisa



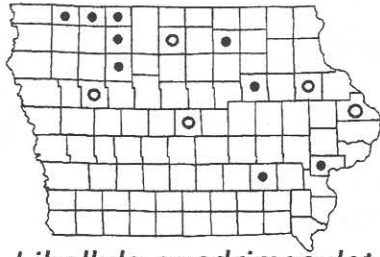
Celithemis eponina



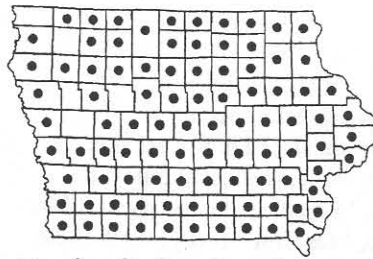
Leucorrhinia intacta



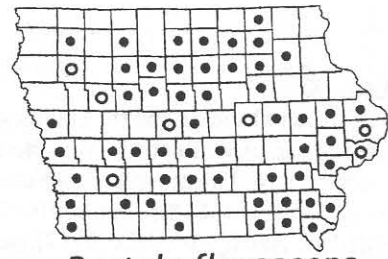
Libellula cyanea



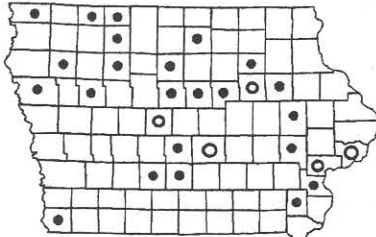
Libellula quadrimaculata



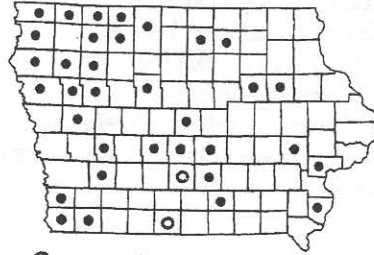
Pachydiplax longipennis



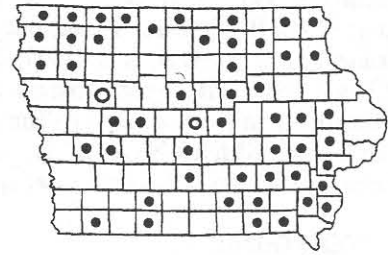
Pantala flavescens



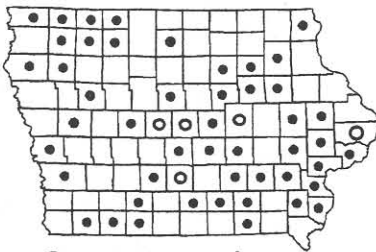
Pantala hymenaea



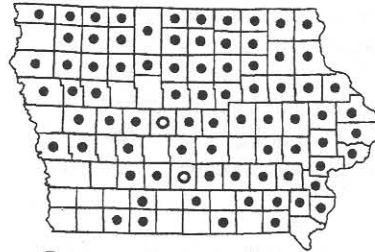
Sympetrum corruptum



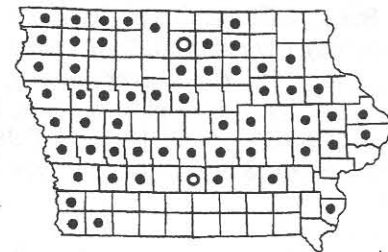
Sympetrum costiferum



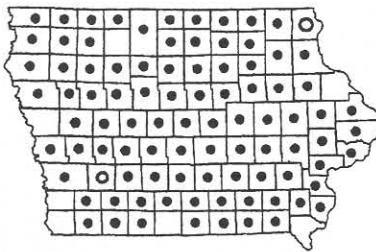
Sympetrum internum



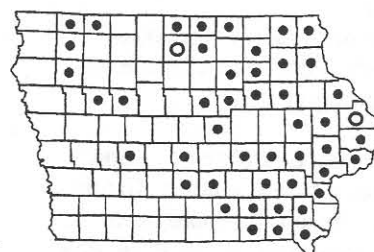
Sympetrum obtrusum



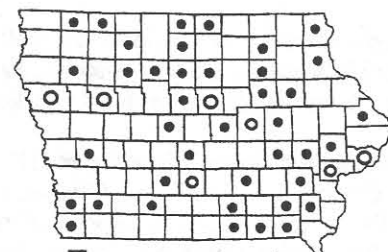
Sympetrum o. fasciatum



Sympetrum rubicundulum



Sympetrum vicinum



Tramea onusta

APPENDIX.

A list of Iowa's Odonata and the counties in which each species was collected or reported. Reports in the literature are placed in parentheses after each county. The counties in which each worker collected follow the reference. 1=Elrod (1898)(Clinton, Hamilton, Marion, Polk, Tama), 2=Miller (1906)(Black Hawk), 3=Wells (1917)(Boone, Muscatine, Story), 4=Whedon (1912)(state wide), 5=Wilson (1909) (along the Mississippi River), 6=Wilson (1921) (Muscatine), 7=Hoffman (1924)(Henry), 8=Yaeger (1932)(Woodbury), 9=Loudon (1933)(Page, Woodbury), 10=Hummel (1978)(Dickinson), 11=Hummel & Haman (1975 & 1977) (Black Hawk, Butler, Grundy, Hancock, Hardin, Muscatine, Tama), 12=Bick et.al. (1977)(Story), JD=Jim Durbin (pers. comm.), AJ=Ann Johnson (pers. comm.), SH=Steven Hummel (pers. comm.), WS=William Smith (pers. comm.) (Allamakee, Clayton, Fayette), ISU=Iowa State University, NMNH=National Museum Natural History, IaLL=Iowa Lakeside Laboratory, {}=questionable record-see species account.

CALOPTERYGIDAE

Calopteryx aequabilis: Benton, Black Hawk (2,11), Bremer, Buchanan, Buena Vista, Butler, Calhoun, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clay, Clayton (SH), Clinton (SH), Delaware, Dickinson (4,10), Dubuque, Emmet, Fayette, Floyd, Franklin, Greene, Grundy, Hamilton, Hancock, Hardin (11), Howard, Humboldt, Ida, Johnson, Jones, Kossuth, Linn, Lyon, Marshall, Mitchell, O'Brien, Osceola, {Page 9}, Palo Alto, Plymouth, Pocahontas, Polk, Sac, Sioux, Story, Tama (1), Webster, Winnebago, Winneshiek, Worth, Wright.

Calopteryx maculata: Reported from all 99 counties. Reported across the state by earlier workers (1-11).

Hetaerina americana: Reported from all counties except: Allamakee, Humboldt, Kossuth, Monroe, Osceola, Palo Alto, Pocahontas, Winnebago, Worth. Reported across the state by earlier workers (1-7,9,11).

Hetaerina titia: Adair, Black Hawk (11), Calhoun, Cherokee (4), Clinton (SH), Crawford, Dallas, Davis, Decatur, Greene, Grundy, Guthrie, Hardin (11), Henry, Iowa, Jackson, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Linn (JD), Louisa, Lucas, Madison, Mahaska, Muscatine (4,11), Page, Polk, Poweshiek, Sac, Scott (SH), Taylor, Wapello, Warren, Washington.

LESTIDAE

Archilestes grandis: Audubon, Black Hawk (11), Cass (AJ), Clayton (SH), Des Moines, Guthrie, Jasper, Johnson, Keokuk, Linn (JD), Mahaska, Marshall, Polk (AJ), Poweshiek, Sac (SH), Story (NMNH), Washington, Woodbury.

Lestes congener: Allamakee (SH), Benton, Black Hawk (11), Cherokee, Clinton, Dickinson (10), Henry, Johnson, Lucas, Mahaska, O'Brien, Palo Alto (SH), Sioux, Wapello.

Lestes disjunctus australis: Allamakee (SH), Black Hawk, Cedar, Chickasaw, Delaware, Dickinson, Dubuque, Emmet, Floyd, Grundy, Hancock, Howard, Johnson, Kossuth, Linn, Lyon, Mahaska, Marion, Muscatine, Osceola, Plymouth, Polk, Ringgold, Sac (SH), Woodbury, Wright.

Lestes dryas: Black Hawk (2,11), Benton, Bremer, Cedar (4), Cherokee (4),

Chickasaw, Clay, Delaware (SH), Dickinson, Fayette (SH), Floyd, Hancock, Johnson (4), Linn, Madison, Muscatine (6,11), Osceola, Pocahontas, Sac (SH), Story (3), Winnebago, Worth, Wright.

Lestes eurinus: Allamakee, Appanoose, Benton, Black Hawk (11), Clayton, Decatur, Delaware, Dickinson (4), Grundy, Jackson, Jasper, Johnson, Linn, Mahaska, Marion, Monroe, Muscatine (5,6,11), Union, Wapello, Warren, Wright.

Lestes forcipatus: Benton, {Black Hawk 2,11}, Floyd, Hancock, {Henry 7-misidentified}, Johnson, Linn, {Muscatine 3,6}, {Polk 1}.

Lestes inaequalis: Allamakee, Chickasaw.

Lestes rectangularis: Adair, Adams, Allamakee, Appanoose, Benton, Black Hawk (2,11), Boone (AJ), Bremer, Buchanan, Buena Vista, Butler, Calhoun, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clarke, Clay, Clayton (5), Clinton, Dallas, Delaware, Des Moines, Dickinson (10), Dubuque, Emmet, Fayette, Franklin, Grundy, Guthrie, Hamilton, Hancock, Hardin, Harrison, Iowa, Jackson, Jefferson, Johnson (4), Keokuk, Kossuth, Linn, Louisa, Lucas, Lyon, Madison, Mahaska, Marion, Marshall, Mills, Mitchell, Monroe, Montgomery, Muscatine (3-6,11), O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Polk, Pottawattamie, Poweshiek, Ringgold, Sac, Scott, Sioux, Story (3), Tama, Taylor, Wapello, Warren, Washington, Wayne, Winnebago, Woodbury, Wright.

Lestes unguiculatus: Adair, Adams, Allamakee, Appanoose, Benton, Black Hawk (2,11), Boone (AJ), Bremer, Buchanan, Buena Vista, Butler, Calhoun, Carroll, Cass, Cedar (4), Cerro Gordo, Cherokee (4), Chickasaw, Clarke, Clay, Clayton, Clinton, Dallas, Des Moines, Dickinson (4,10), Dubuque, Emmet, Fayette, Floyd, Fremont, Greene, Grundy, Guthrie, Hamilton, Hancock, Hardin (4,11), Harrison, Henry (7), Howard, Humboldt, Ida, Iowa, Jackson, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Kossuth, Lee, Linn, Louisa, Lucas, Lyon, Madison, Mahaska, Marion, Marshall, Mitchell, Monona, Montgomery, Muscatine (5,6,11), O'Brien, Osceola, Page, Palo Alto, Plymouth, Pocahontas, Polk (1), Pottawattamie, Poweshiek, Ringgold, Sac, Scott, Sioux, Story (3), Tama (11), Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Winnebago, Winneshiek, Woodbury, Worth, Wright.

COENAGRIONIDAE

Amphiagrion cf. *saucium*: Adair, Allamakee (SH), Audubon, Black Hawk (2,11), Boone, Buchanan, Buena Vista, Carroll, Cass, Cedar, Cherokee, Chickasaw, Clay, Clayton, Clinton, Crawford, Delaware, Dickinson (10), Dubuque, Fayette, Floyd, Fremont, Grundy, Hancock, Hardin, Henry, Ida, Jackson, Jasper, Johnson, Jones, Keokuk, Linn, Lyon, Madison, Marshall, Monona, Montgomery, Muscatine (6), O'Brien, Osceola, Plymouth, Sac (SH), Scott (SH), Shelby, Sioux, Wapello, Winnebago, Worth.

Argia alberta: Buena Vista, Calhoun, Carroll, Cherokee, Crawford, Fremont, Ida, Mills, Monona, Osceola, Plymouth, Pottawattamie, Sac.

Argia apicalis: Reported from all counties except: Clay, Emmet, Palo Alto, Shelby, Wright. Reported across the state by earlier workers (1,3-8,11).

Argia emma: Crawford.

Argia fumipennis violacea: Adair, Appanoose, Benton, Boone, Buchanan, Buena Vista, Butler, Calhoun, Cedar, Cherokee (4), Clarke, Clayton, Clinton, Crawford, Dallas, Davis, Decatur, Delaware, Des Moines, Dickinson (4), Greene, Guthrie, Hardin (4), Henry, Humboldt, Ida, Iowa, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Lee, Louisa, Lucas, Lyon, Madison, Mahaska, Marion, Mills, Monona, Monroe, Muscatine, O'Brien, Plymouth, Polk, Poweshiek, Ringgold, Sac, Scott (SH), Sioux, Story, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Winneshiek.

Argia moesta: Allamakee (JD), Adair, Benton, Black Hawk (11), Cass (AJ), Cedar, Clarke, Clayton, Clinton, Dallas, Davis, Decatur, Delaware, Des Moines (5), Dubuque, Fayette, Floyd, Franklin, Greene, Grundy, Guthrie, Hamilton, Hardin (11), Henry (7), Howard, Iowa, Jackson, Jefferson, Johnson (4), Jones, Lee, Linn, Louisa, Lucas, Madison, Mahaska, Marshall, Mills, Muscatine (5,6,11), Page, Polk, Ringgold, Sac, Scott, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Winneshiek.

Argia plana: Adair, Audubon, Benton, Black Hawk, Boone (AJ), Buchanan, Buena Vista, Carroll, Cass, Cedar, Cerro Gordo, Cherokee, Clarke, Clayton, Clinton, Dallas, Des Moines, Dubuque, Guthrie, Hamilton, Hardin, Harrison, Ida, Jackson, Jasper, Jones, Lee, Madison, Marshall, Monona, O'Brien, Page, Plymouth, Polk, Pottawattamie, Poweshiek, Sac, Scott, Shelby, Sioux, Story, Warren, Washington, Woodbury.

Argia tibialis: Adair, Appanoose, Benton, Black Hawk, Bremer, Buchanan, Butler, Carroll, Cedar, Cherokee (4), Chickasaw, Clarke, Clayton, Clinton (5), Dallas, Davis, Decatur, Delaware, Des Moines (5), Fayette, Floyd, Franklin, Grundy, Hamilton, Hardin, Henry, Iowa, Jasper, Jefferson, Johnson (4), Keokuk, Lee, Linn, Louisa, Lucas, Madison, Marion, Marshall, Mills, Mitchell, Monroe, Montgomery, Muscatine (5,11), Page, Plymouth, Polk, Poweshiek, Ringgold, Sac (SH), Scott (5), Sioux, Story, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, Winneshiek.

Coenagrion angulatum: Carroll (4), Greene, Guthrie, Kossuth, Plymouth, Shelby, Woodbury (4).

Coenagrion resolutum: Black Hawk (11), Carroll (4), Cherokee (4), Delaware, Dickinson (10), Emmet (SH), Greene, Guthrie, Johnson (4), Kossuth, Linn, Lyon, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Polk, Sac (SH), Sioux, Winnebago, Winneshiek, Woodbury (4).

Enallagma anna: Adair, Allamakee, Audubon, Benton, Black Hawk, Boone, Bremer, Buchanan, Buena Vista, Butler, Calhoun, Carroll, Cass, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clay, Clayton, Clinton, Crawford, Dallas, Davis, Delaware, Dickinson, Dubuque, Emmet, Fayette, Franklin, Greene, Grundy, Guthrie, Hamilton, Hancock, Hardin, Harrison, Humboldt, Ida, Iowa, Jackson, Jasper, Johnson, Jones, Keokuk, Kossuth, Linn, Louisa, Lyon, Mahaska, Marion, Marshall, Monona, Monroe, Muscatine, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Polk, Pottawattamie, Poweshiek, Sac, Scott, Shelby, Sioux, Story (12), Tama, Wapello, Washington, Webster, Winnebago, Winneshiek, Woodbury, Worth, Wright.

Enallagma antennatum: Our records from all counties except: Allamakee, Dubuque, Emmet, Ida, Warren (AJ), Wright. Reported across the state by earlier workers (1,2,4-7,9-11).

Enallagma aspersum: Adair, Adams, Allamakee, Appanoose, Benton, Black Hawk (SH), Boone, Buchanan, Carroll, Cass, Cedar, Clarke, Clinton, Davis, Decatur, Delaware, Des Moines, Dubuque, Fayette, Floyd, Fremont, Greene, Guthrie, Hancock, Hardin, Iowa, Jackson, Jasper, Jefferson, Johnson, Jones, Lee, Linn, Lucas, Mahaska, Marion, Monroe, Montgomery, Muscatine (3), Polk, Ringgold, Scott, Story, Taylor, Union, Van Buren, Wapello, Warren, Washington.

Enallagma basidens: Adair, Adams, Appanoose, Benton, Black Hawk, Buchanan, Carroll, Cass, Cedar, Clarke, Clayton, Clinton, Davis, Decatur, Delaware, Des Moines, Fayette, Floyd, Fremont, Hardin, Harrison, Henry, Humboldt, Jackson, Jefferson, Johnson, Keokuk, Kossuth, Lee, Linn, Lucas, Madison, Mahaska, Marion, Mills, Monona, Monroe, Muscatine, Page, Plymouth, Polk (AJ), Sac, Scott, Story, Union, Van Buren, Wapello, Warren, Washington, Wayne, Woodbury, Worth.

Enallagma boreale: Allamakee (SH), Black Hawk (11), Dickinson, Floyd, Hancock (11), Muscatine (6,11).

Enallagma carunculatum: Adair, Adams, Allamakee, Audubon, Benton, Black Hawk, Boone, Bremer, Buchanan, Buena Vista, Butler, Calhoun, Carroll, Cass, Cerro Gordo, Cherokee (4), Chickasaw, Clarke, Clay, Clayton, Clinton, Crawford, Dallas, Davis, Delaware, Des Moines, Dickinson (4), Dubuque, Emmet, Fayette, Floyd, Franklin, Greene, Guthrie, Hamilton, Hancock, Hardin, Harrison, Henry (7), Howard, Humboldt, Ida, Iowa, Jackson, Jasper, Johnson, Jones, Keokuk, Kossuth, Lee, Linn, Lucas, Lyon, Madison, Marshall, Mills, Mitchell, Monona, Monroe, Montgomery, Muscatine (5,11), O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Polk, Pottawattamie, Poweshiek, Sac, Scott, Shelby, Sioux, Story, Tama, Taylor, Union, Warren, Washington, Webster, Winnebago, Winneshiek, Woodbury, Worth, Wright.

Enallagma civile: Reported from all 99 counties. Reported across the state by earlier workers (3,4,6,7,9-11).

Enallagma clausum: Dickinson, Emmet, Hancock, Kossuth.

Enallagma cyathigerum: Adams, Benton, Boone, Bremer, Buena Vista, Calhoun, Cass, Cerro Gordo, Chickasaw, Clay, Clinton, Crawford, Dallas, Dickinson (10), Emmet, Fayette, Floyd, Franklin, Fremont, Greene, Guthrie, Hamilton, Hancock, Howard, Ida, Jasper, Kossuth, Lyon, Mitchell, Montgomery, O'Brien, Osceola, Pocahontas, Sac (SH), Sioux, Taylor, Winnebago, Winneshiek, Worth.

Enallagma ebrium: Allamakee, Black Hawk (2,11), Bremer, Buchanan, Calhoun, Chickasaw, Clayton (SH), Clinton, Delaware, Dickinson (10), Floyd, Franklin, Grundy, Howard, Jackson, Jasper (SH), Linn, Mitchell, Muscatine (5,6,11), O'Brien, Plymouth, Polk (1), Scott (SH), Shelby, Winneshiek.

Enallagma exsulans: Adair, Allamakee, Appanoose, Benton, Black Hawk, Boone, Bremer, Buchanan, Cedar, Chickasaw, Clarke, Clayton, Clinton, Davis, Decatur, Delaware, Des Moines, Dickinson, Fayette, Franklin, Grundy, Guthrie, Hamilton, Hardin (11), Harrison, Henry (7), Howard, Iowa, Jackson (JD), Jasper, Jefferson, Johnson, Jones, Lee, Linn, Louisa, Lucas, Marion, Mahaska, Marion, Marshall, Mills, Mitchell, Monroe, Muscatine, Polk, Poweshiek, Ringgold, Sac, Scott, Story, Taylor, VanBuren, Wapello, Washington, Wayne, Winneshiek.

Enallagma geminatum: Adair, Adams, Allamakee, Appanoose, Audubon, Benton, Black Hawk, Bremer, Buchanan, Buena Vista, Carroll, Cass, Cedar, Cherokee, Chickasaw, Clarke, Clay, Clayton, Clinton, Crawford, Dallas, Davis, Decatur, Delaware, Des Moines, Dickinson (10), Dubuque, Emmet, Fayette, Franklin, Fremont, Greene, Guthrie, Hancock, Hardin (11), Harrison, Henry, Iowa, Jackson, Jasper, Jefferson, Johnson, Jones, Keokuk, Lee, Linn, Louisa, Madison, Mahaska, Marion, Marshall, Mills, Monona, Monroe, Montgomery, Muscatine (5,6,11), Page, Palo Alto, Polk, Pottawattamie, Poweshiek, Ringgold, Sac, Scott, Shelby, Sioux, Story, Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, Winneshiek, Woodbury, Worth.

Enallagma hageni: Adams, Allamakee, Audubon, Benton, Black Hawk (2,11), Boone, Bremer, Buchanan, Buena Vista, Butler, Calhoun, Carroll, Cass, Cedar, Cerro Gordo, Cherokee (4), Chickasaw, Clay, Clayton (5), Clinton, Crawford, Dallas, Delaware, Dickinson (4,10), Dubuque, Emmet, Fayette, Floyd, Franklin, Fremont, Greene, Grundy (11), Guthrie, Hamilton, Hancock, Hardin, Harrison, Howard, Humboldt, Ida, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Kossuth, Lee, Linn, Lyon, Madison, Mahaska, Marshall, Mills, Mitchell, Monona, Montgomery, Muscatine (5,6,11), O'Brien, Osceola, Page, Palo Alto, Plymouth, Pocahontas, Polk (1), Pottawattamie, Poweshiek, Sac, Scott (SH), Shelby, Sioux, Story (4), Tama, Union, Wapello, Webster, Winnebago, Winneshiek, Woodbury (8,9), Worth, Wright.

Enallagma signatum: Adair, Adams, Allamakee, Appanoose, Audubon, Benton, Black Hawk, Boone, Bremer, Buchanan, Butler, Calhoun, Cass, Cedar, Cherokee (4), Chickasaw, Clarke, Clayton, Clinton (1), Crawford, Dallas, Davis, Decatur, Delaware, Des Moines, Dickinson (4,10), Dubuque, Floyd, Franklin, Fremont, Greene, Grundy (11), Guthrie, Hamilton, Hardin (11), Harrison, Henry (7), Howard, Jackson, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Lee, Linn, Louisa, Lucas, Madison, Mahaska, Marion, Mills, Monona, Monroe, Montgomery, Muscatine (3,6,11), Page, Palo Alto, Pottawattamie, Poweshiek, Ringgold, Sac, Scott, Shelby, Sioux, Story, Tama, Taylor, Union, Van Buren, Warren, Washington, Wayne, Worth.

Enallagma traviatum: Adams, Appanoose, Benton, Buchanan, Cass, Cedar, Davis, Greene, Hardin, Henry, Iowa, Jackson, Jefferson, Johnson, Jones, Keokuk, Lee, Mahaska, Mills, Muscatine, Page, Poweshiek, Ringgold, Wapello, Washington

Enallagma vesperum: Appanoose, Cherokee, Decatur, Dickinson (10), Jefferson, Marion, Wapello, Warren (AJ).

Ischnura hastata: Benton, Black Hawk (2), Cass (AJ), Fayette, Floyd, Hamilton, Hancock, Jefferson, Johnson (NMNH), Keokuk, Linn, Madison, Mahaska, Mills, Montgomery, Muscatine, Page, Pocahontas, Polk (1), Sac, Union, Van Buren, Warren, Winnebago.

Ischnura posita: Appanoose, Audubon, Buchanan, Calhoun, Cedar, Clarke, Clinton, Davis, Decatur, Des Moines, Dubuque, Fayette, Floyd, Guthrie, Henry, Jackson, Jasper, Jefferson, Johnson (4), Keokuk, Lee, Linn, Louisa, Lucas (AJ), Madison, Marion, Marshall, Monroe, Muscatine (3,6), Polk (AJ), Ringgold, Scott, Taylor, Van Buren, Wapello, Warren (AJ), Washington, Wayne.

Ischnura verticalis: Reported from all 99 counties. Widely reported by earlier workers (1-7,9-11).

Nehalennia irene: Adams, Benton, Black Hawk (2,11), Bremer, Buchanan, Buena Vista, Calhoun, Cedar (4), Cerro Gordo, Cherokee (4), Chickasaw, Clinton (1), Dickinson (4,10), Dubuque, Emmet, Fayette (NMMNH), Floyd, Greene, Hamilton, Hancock, Howard, Humboldt, Johnson (4), Kossuth, Linn, Mahaska, Muscatine (4-6,11), Page (9), Palo Alto, Pocahontas, Polk (1,3), Sac, Story (3,4), Tama, Wapello, Warren (AJ), Winnebago, Winneshiek, Woodbury (8,9), Worth.

AESHNIDAE

Aeshna canadensis: Allamakee (SH), Bremer, Butler (10), Clayton, Linn, Scott, Story.

Aeshna constricta: Allamakee, Black Hawk (11), Boone (3), Bremer, Buena Vista, Butler, Carroll, Cedar, Cerro Gordo, Cherokee (4), Clay, Clayton, Clinton, Dickinson (4,10), Dubuque, Emmet, Fayette, Greene, Grundy, Guthrie, Hancock (SH), Henry (7), Ida, Jasper, Johnson (4), Keokuk, Lee, Linn, Louisa, Lucas, Lyon, Mahaska, Muscatine (6), O'Brien, Osceola, Palo Alto (SH), Plymouth, Polk, Ringgold, Sac, Scott, Story (3), Tama, Union, Van Buren, Warren (AJ), Woodbury.

Aeshna interrupta lineata: Butler (11), Cherokee, Dickinson, Humboldt, Kossuth, Lyon, Pocahontas, Polk, Sac (SH), Webster.

Aeshna multicolor: Crawford, Dubuque, Kossuth, Madison, Mills, O'Brien, Sioux, Woodbury.

Aeshna mutata: Lee (JD).

Aeshna tuberculifera: Allamakee.

Aeshna umbrosa: Allamakee, Audubon, Black Hawk (11), Boone, Bremer, Buchanan, Buena Vista, Butler (11), Calhoun, Cass (AJ), Cedar, Cerro Gordo, Cherokee, Chickasaw, Clay, Clayton (SH), Clinton, Crawford, Delaware, Dickinson, Emmet, Fayette, Greene, Grundy (11), Guthrie, Hamilton, Hardin, Henry (7), Howard, Iowa, Jackson, Jasper, Johnson, Jones, Keokuk, Lee, Louisa, Lucas, Lyon, Madison, Marshall, Monroe, Montgomery, Muscatine, O'Brien, Osceola, Palo Alto, Pocahontas, Poweshiek, Sac, Scott (SH), Shelby, Sioux, Story, Tama, Warren (AJ), Washington, Webster, Winneshiek, Woodbury, Worth, Wright.

Aeshna verticalis: Allamakee, Cherokee (4), Clayton, {Dickinson 10}, Louisa, Muscatine (3,5), Story (3), Washington.

Anax junius: Reported from all 99 counties. Reported across the state by earlier workers (1-11).

Boyeria vinosa: Adair, Adams, Allamakee (SH), Appanoose, Audubon, Benton, Black Hawk, Boone (AJ), Buchanan, Butler, Carroll, Cass (AJ), Cedar, Cherokee (4), Clarke, Clayton, Clinton, Dallas, Davis, Decatur, Delaware, Des Moines, Dubuque, Fayette, Franklin, Greene, Grundy, Guthrie, Hamilton, Hardin (4), Howard, Iowa, Jackson, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Lee, Linn, Louisa, Lucas, Lyon, Madison, Mahaska, Marion, Marshall, Mitchell, Monroe, Muscatine, Polk, Poweshiek, Ringgold, Sac, Scott, Shelby, Story (3), Tama, Taylor, Union, Van Buren, Wapello, Warren, Washington,

Wayne, Winneshiek, Wright.

Epiaeschna heros: Johnson (4), Story (ISU).

Nasiaeschna pentacantha: Black Hawk (2), Decatur, Des Moines, Henry, Lee.

GOMPHIDAE

Arigomphus cornutus: Black Hawk (2), Boone, Bremer, Buchanan, Buena Vista, Cherokee, Chickasaw, Crawford, Davis, Dickinson, Floyd, Hamilton, Hancock, Henry (7-as *A. furcifer*), Howard, Johnson (4-as *G. whedoni*), Kossuth, Muscatine (11), O'Brien, Pocahontas, Shelby, Story (3-as *A. furcifer*), Tama, Winnebago, Winneshiek.

Arigomphus submedianus: Adair, Adams, Appanoose, Audubon, Benton, Black Hawk (11), Bremer, Buchanan, Butler, Carroll, Cass, Cedar, Chickasaw, Clarke, Clinton, Crawford, Decatur, Delaware, Des Moines, Fremont, Guthrie, Hardin, Henry (7), Ida, Iowa, Jasper, Jefferson, Johnson, Jones, Keokuk, Lee, Louisa, Lucas, Madison, Marion, Marshall, Mills, Monroe, Montgomery, Muscatine (3-as *A. pallidus*), Page, Plymouth, Ringgold, Sac, Scott, Story, Tama, Union, Van Buren, Warren, Washington, Wayne, Woodbury.

Dromogomphus spoliatus: Cherokee (4), Clarke, Decatur, Des Moines, Henry, Keokuk, Lee, Lucas, Madison, Mahaska, Monroe, Polk (AJ), Van Buren, Wapello, Warren, Washington.

Gomphus externus: Adams, Allamakee (5,WS), Appanoose, Benton, Black Hawk (11), Boone, Bremer, Buchanan, Buena Vista, Butler, Calhoun, Carroll, Cass, Cedar, Cherokee, Chickasaw, Clay, Clayton (5), Clinton (5), Crawford, Dallas, Davis, Decatur, Des Moines, Dickinson (10), Dubuque, Emmet, Fayette, Floyd, Greene, Grundy, Hamilton, Hardin, Henry (7), Humboldt, Ida, Iowa, Jackson, Jasper, Johnson, Keokuk, Kossuth, Lee, Linn, Louisa, Lyon, Mahaska, Marshall, Montgomery, Muscatine (3,5,6), O'Brien, Osceola, Page, Plymouth, Pocahontas, Polk, Poweshiek, Ringgold, Sac, Scott, Story, Tama, Union, Van Buren, Washington, Webster, Winnebago, Woodbury (9).

Gomphus fraternus: Black Hawk (2,11), Boone (3), Bremer, Buchanan, Chickasaw, Clayton, Delaware, {Dickinson 10}, Dubuque, Fayette (SH), Franklin, Hancock (IaLL), Hardin (4), Howard, Jackson, Johnson (4), Linn, Marshall (4), Mitchell, {Muscatine 3}, Winneshiek, Woodbury (4), Wright (4).

Gomphus grasilinellus: Appanoose, Benton, Black Hawk (SH), Buchanan, Buena Vista, Calhoun, Cherokee, Clarke, Clay, Decatur, Des Moines, Dickinson, Franklin, Hancock, Hardin, Henry (7), Jefferson, Johnson (4), Keokuk, Lee, Linn, Lyon, Muscatine (11), O'Brien, Osceola, Ringgold, Sac (SH), Sioux, Union, Wapello, Webster (SH).

Gomphus militaris: Fremont, Mills.

Gomphus quadricolor: Fayette.

Gomphus vastus: Allamakee (5), Buchanan, Clayton, Clinton (1,5), Des Moines, Dubuque, Henry (7), Jackson, Johnson, Linn, Louisa, Muscatine (3,5,6), Scott.

Ophiogomphus rupinsuliensis: Fayette, Howard.

Ophiogomphus sp.: Benton, Black Hawk, Buchanan.

Progomphus obscurus: Appanoose, Benton, Clarke, Dallas, Davis, Decatur, Des Moines, Fayette (NMNH), Greene, Henry (7), Iowa, Jasper, Jefferson, Keokuk, Lee, Lucas, Madison, Mahaska, Marshall, Monroe, Muscatine, Polk, Poweshiek, Ringgold, Story, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne.

Stylurus amnicola: Allamakee (WS), Audubon, Benton, Black Hawk (11), Butler, Carroll, Cass, Cherokee (4), Chickasaw, Dallas, Decatur, Fayette, Grundy, Iowa, Jackson, Jasper, Johnson, Jones, Lyon, Madison, Mahaska, Montgomery, Muscatine (3,5,6), O'Brien, Pocahontas, Polk (1), Poweshiek, Sac, Story, Tama, Van Buren, Washington.

Stylurus intricatus: Audubon, Page, Woodbury (ISU).

Stylurus notatus: Allamakee, Audubon, Benton, Black Hawk, Buchanan, Butler, Carroll, Cass, Clayton, Clinton, Dallas, Dickinson, Dubuque, Grundy, Guthrie, Iowa, Jackson, Jasper, Jefferson, Lee, Linn, Madison, Marshall, Muscatine (3,6), Polk, Poweshiek, Sac, Scott, Story, Tama, Warren, Washington, Webster.

Stylurus plagiatus: Allamakee, Audubon, Cass, Clayton, Clinton, Dallas, Decatur, Des Moines, Henry (7), Iowa, Jackson, Jasper, Jefferson, Johnson, Lee, Louisa, Madison, Mahaska, Marion, Marshall, Monroe, Muscatine (3,6), Polk, Ringgold, Scott, Story, Van Buren, Warren, Washington.

Stylurus spiniceps: Bremer.

MACROMIIDAE

Macromia illinoensis: Black Hawk (2), Clayton (SH), Davis, Decatur, Delaware, Des Moines, Fayette (SH), Howard, Jefferson, Jones, Lee, Linn, Lucas, Madison (AJ), Monroe, Muscatine (6), Van Buren, Washington.

Macromia taeniolata: Allamakee, Des Moines, Dubuque, Henry (7), Jackson (JD), Lee, Louisa, Muscatine, Scott.

CORDULIIDAE

Epitheca cynosura: Reported from all counties except: Audubon, Carroll, Lyon, Mitchell, Wright. Collected across the state by earlier workers (2,4,5,10,11).

Epitheca princeps: Reported from all counties except: Chickasaw, Clay, Emmet, Hancock, Mitchell, Pocahontas, Winnebago, Wright. Reported by early workers from eastern Iowa (2,3,5-7) and later in western Iowa (10).

Neurocordulia molesta: Allamakee (WS), Boone (ISU), Clayton (WS), Johnson, Monona, Polk.

Neurocordulia yamaskanensis: Allamakee (WS), Clayton (WS).

Somatachlora ensigera: Cherokee, Clay, Dallas, Dickinson, Emmet, Guthrie, Hamilton, Hardin, Lyon, O'Brien, Osceola, Palo Alto, Pocahontas, Sac,

Sioux, Story (3-as *S. tenebrosa*, 9-as *S. linearis*), Webster, Winneshiek (NMNH).

LIBELLULIDAE

Celithemis elisa: Allamakee, Black Hawk (11), Buchanan, Butler, Calhoun, Cedar, Clarke, Clayton, Clinton, Des Moines, Fayette, Floyd, Franklin, Henry (7), Humboldt, Johnson, Jones, Keokuk, Kossuth, Lee, Madison, Mahaska, Marion, Monroe, Muscatine (4,6,11), Osceola, Page, Pocahontas, Polk, Sac, Scott, Union, Van Buren, Wapello, Washington, Webster, Winnebago.

Celithemis eponina: Adair, Adams, Allamakee, Appanoose, Audubon, Benton, Black Hawk, Boone (AJ), Bremer, Buchanan, Butler, Calhoun, Cass, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clarke, Clayton, Clinton (1), Dallas, Davis, Des Moines, Dickinson (10), Fayette, Floyd, Franklin, Fremont, Greene, Grundy, Hamilton, Hancock, Hardin, Harrison, Henry, Howard, Humboldt, Iowa, Jackson, Jasper, Jefferson, Johnson, Jones, Keokuk, Kossuth, Lee, Linn (JD), Lucas (AJ), Madison, Mahaska, Marion, Marshall, Mills, Mitchell, Monona, Monroe, Montgomery, Muscatine (3,6), Osceola, Page (9), Pocahontas, Polk, Pottawattamie, Poweshiek, Sac, Scott, Sioux, Story, Tama (11), Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne, Webster, Winnebago, Winneshiek, Woodbury (9), Wright.

Erythemis simplicicollis: Reported from all 99 counties. Reported by most previous workers (2-11).

Leucorrhinia intacta: Allamakee, Benton, Black Hawk (2,11), Boone, Bremer, Buchanan, Butler, Cass, Cedar (4), Cerro Gordo, Cherokee (4), Chickasaw, Clay, Clayton (SH), Clinton, Crawford, Dallas, Davis, Delaware, Dickinson (4,10), Dubuque, Emmet, Fayette, Floyd, Franklin, Fremont, Greene, Grundy, Guthrie, Hancock, Hardin (11), Howard, Humboldt, Iowa, Jackson (1), Jasper, Jefferson, Johnson (4), Keokuk, Kossuth, Linn, Lucas, Lyon, Mahaska, Marion, Marshall, Mills, Monona, Muscatine (6,11), O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Polk, Poweshiek, Sac, Shelby, Sioux, Story (3,4), Tama, Union, Winnebago, Winneshiek, Woodbury, Worth, Wright.

Libellula cyanea: Decatur, Lee, Van Buren.

Libellula luctuosa: Reported from all 99 counties. Reported by all the previous workers.

Libellula lydia: Reported from all 99 counties. Reported by all the previous workers.

Libellula pulchella: Reported from all 99 counties. Reported by all the previous workers.

Libellula quadrimaculata: Black Hawk, Delaware (SH), Dickinson (4,10), Emmet, Floyd, Hancock (11), Jackson (1), Keokuk, Muscatine, Osceola, Palo Alto, Pocahontas, Sac (SH), Story (3,4).

Pachydiplax longipennis: Reported from all counties except: Calhoun, Crawford, Ida, Lyon, O'Brien. Reported by most of the previous workers (1-7,9,11).

Pantala flavescens: Adams, Allamakee (JD), Audubon, Benton, Black Hawk

(11), Boone (AJ), Bremer, Butler, Calhoun, Cass (AJ), Cedar, Cerro Gordo, Cherokee (4), Chickasaw, Clinton (SH), Dallas, Davis, Decatur, Des Moines, Fayette, Floyd, Franklin, Fremont, Guthrie, Hamilton, Hancock, Hardin, Harrison, Henry, Howard, Humboldt, Jackson, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Lee, Linn, Madison, Marion, Mills, Monona, Muscatine (3,6,11), O'Brien, Palo Alto, Pocahontas, Polk, Pottawattamie, Sac (SH), Scott (SH), Story, Tama (SH), Union, Van Buren, Wapello, Warren, Washington, Webster, Wright.

Pantala hymenaea: Black Hawk (11), Boone (AJ), Bremer, Buchanan, Cerro Gordo, Cherokee (4), Dickinson, Emmet, Fremont, Grundy, Hamilton, Hardin, Henry, Jasper (SH), Johnson (4), Jones (JD), Linn, Louisa, Lyon, Madison, Muscatine (3,6), Palo Alto, Pocahontas, Polk, Sac, Scott (SH), Warren, Woodbury, Wright.

Perithemis tenera: Reported from all counties except: Clay and Lyon. Reported by some of the previous workers (3-6,9-11).

Sympetrum ambiguum: Muscatine.

Sympetrum corruptum: Audubon, Black Hawk (11), Buchanan, Buena Vista, Cass, Cerro Gordo, Cherokee (4), Clay, Crawford, Dallas, Decatur (NMNH), Des Moines, Dickinson (4,10), Emmet, Floyd, Fremont, Ida, Jasper, Johnson, Kossuth, Lyon, Marion (1), Mills, Monroe, Muscatine (3,6,11), Osceola, Page (9), Palo Alto, Plymouth, Polk, Sac, Sioux, Story (3), Warren (AJ), Webster, Woodbury (8).

Sympetrum costiferum: Allamakee, Audubon, Benton, Black Hawk (11), Butler (11), Carroll, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clay, Clayton, Davis, Des Moines, Dickinson (10), Emmet (SH), Fayette, Floyd, Greene, Grundy, Hamilton, Henry (7, as *S. vicinum*), Iowa, Johnson, Jones, Keokuk, Kossuth, Linn, Louisa, Lyon, Mahaska, Marshall, Mitchell, Monroe, Muscatine, O'Brien, Osceola, Page, Plymouth, Polk, Ringgold, Sac (SH), Shelby, Sioux, Story (NMNH), Union, Van Buren, Wapello, Warren, Washington, Winnebago, Winneshiek.

Sympetrum internum: Allamakee, Black Hawk (11), Boone (AJ), Bremer, Buchanan, Butler, Cedar, Cherokee, Clay, Clinton (SH), Crawford, Davis, Des Moines, Dickinson (10), Emmet, Fayette, Greene, Grundy, Hamilton, Hancock, Harrison, Henry (7, as *S. decisum*), Jasper, Johnson, Jones, Keokuk, Linn, Louisa, Lucas, Lyon, Madison, Mahaska, Marshall, Monroe, Muscatine, O'Brien, Osceola, Page, Palo Alto, Plymouth, Polk, Pottawattamie, Poweshiek, Ringgold, Sac, Scott, Story (NMNH), Tama (11), Taylor, Union, Wapello, Warren (AJ), Washington.

Sympetrum obtusum: Adair, Allamakee, Appanoose, Benton, Black Hawk (11), Boone (AJ), Bremer, Buchanan, Buena Vista, Butler, Carroll, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clay, Clayton, Clinton (1), Crawford, Delaware, Des Moines, Dickinson (10), Dubuque, Emmet, Fayette, Floyd, Franklin, Greene, Grundy, Guthrie, Hamilton, Hancock (11), Hardin, Harrison, Henry, Howard, Humboldt, Ida, Iowa, Jackson, Jasper, Jefferson, Johnson (4), Jones, Keokuk, Kossuth, Linn, Louisa, Lucas, Lyon, Madison, Mahaska, Marion, Marshall, Mitchell, Muscatine (3,11), O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Polk, Ringgold, Sac, Scott, Shelby, Story (3), Tama (11), Taylor, Union, Van Buren, Wapello, Warren (AJ), Washington, Winnebago, Winneshiek, Woodbury, Worth, Wright.

Sympetrum occidentale fasciatum: Adair, Allamakee (JD), Audubon, Black Hawk, Bremer, Buchanan, Butler, Calhoun, Carroll, Cass, Cedar, Cerro Gordo, Cherokee (4-as S. semicinctum), Clay, Clinton, Crawford, Dallas, Delaware, Des Moines, Dickinson, Emmet, Fayette, Floyd, Franklin, Fremont, Guthrie, Hamilton, Hancock (11), Harrison, Ida, Jackson, Jasper, Johnson, Jones, Keokuk, Kossuth, Linn, Lyon, Marion, Marshall, Mills, Mitchell, Monona, O'Brien, Osceola, Page, Plymouth, Polk, Pottawattamie, Poweshiek, Sac, Shelby, Sioux, Tama, Warren (AJ), Webster, Woodbury, Wright.

Sympetrum rubicundulum: Our records from all counties except: Allamakee (SH), Cass (AJ), Decatur, Dubuque, Fremont, Lee, Mills, Monona, and Palo Alto. Reported across the state by earlier workers (1,3,4,6,7,9-11).

Sympetrum vicinum: Allamakee, Black Hawk (11), Bremer, Buchanan, Butler(11), Calhoun, Cedar, Cerro Gordo, Cherokee, Chickasaw, Clayton, Clinton, Davis, Dickinson, Dubuque, Fayette, Grundy, Guthrie, Hancock (11), Hardin, Henry (7), Iowa, Jackson (SH), Jefferson, Johnson (4), Jones, Keokuk, Lee, Linn, Louisa, Marion, Marshall, Mitchell, Monroe, Muscatine (3,5,11), O'Brien, Osceola, Polk (1), Poweshiek, Sac, Scott, Van Buren, Wapello, Warren, Washington, Winnebago, Winneshiek, Worth.

Tramea carolina: {Cherokee 4}, Mahaska, {Story 3}.

Tramea lacerata: Our records from all counties except: Audubon (4) and Calhoun. Reported by most of the previous workers (1,3,4,6-11).

Tramea onusta: Allamakee, Appanoose, Benton, Black Hawk (11), Boone, Bremer, Buchanan, Cedar, Cherokee, Chickasaw, Clayton, Davis, Dickinson (10), Franklin, Fremont, Hamilton, Hancock, Hardin (11), Henry (7), Humboldt, Iowa, Jackson, Jefferson, Johnson (4), Jones (JD), Madison, Mahaska, Marshall, Mills, Monroe, Montgomery, Muscatine (4,6,11), Osceola, Page (9), Palo Alto, Pocahontas, Polk, Sac (SH), Scott (SH), Shelby, Tama (11), Union, Van Buren, Warren (AJ), Washington, Winnebago, Woodbury (8,9), Worth, Wright.

Tramea red species: Seen in Adams, Butler, Cerro Gordo, Clarke, Clay, Clinton, Delaware, Des Moines, Emmet, Floyd, Grundy, Hardin, Jasper, Keokuk, Lucas, Mitchell, Muscatine, O'Brien, Ringgold, Scott, Story, Taylor, Wapello, Warren, Webster.